XVI WORLD WINTER SERVICE AND ROAD RESILIENCE CONGRESS
CALGARY, CANADA - 7-11 FEBRUARY 2022

Session Report

Date: 12/04/2022
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TECHNICAL SESSION R 10.1 ROAD NETWORK OPERATIONS TO INCREASED RESILIENCE - PART 1

WEDNESDAY, FEBRUARY 9 18:30 - 20:00 (CALGARY)
GMT : 02/10| 01:30 - 03:00 PARIS : 02/10| 02:30 - 04:00 NEW DELHI : 02/10| 07:00 - 08:30 TOKYO : 02/10| 10:30 - 12:00 SYDNEY : 02/10| 12:30 - 14:00

1. KEYWORDS

Avalanche, sensor network, resilience, IRI, profilometer, road network operations, ITS, innovation, passable roads, disaster

2. PRESENTATION OF THE SESSION

When disruptions happen the ability of road operators to deliver information properly to road users may be compromised and the efficiency of road operations may be jeopardized. Hazards occurring along the network (like winter extreme situations or high impact events for example) can be a challenge for many Road Operators in terms of ensuring the viability of the road, and therefore the mobility of people and goods along the network itself.

New technologies offer new possibilities to engage with road users and avoid disruptions.

This session aims at presenting some of most promising applications of new technologies to Road Network Operators and ITS solutions.

3. PROGRAMME OF THE SESSION

Session Chair: Yan St-Yves, Member of TC 2.4, Canada-Quebec
Session Organiser: Valentina GALASSO, Chair of TC 2.4, Italy
Session Secretary: Daniel RUSSOMANNO, Spanish-speaking secretary of TC 2.4, Argentina

Q&A Moderator: Yan St-Yves, Member of TC 2.4, Canada-Quebec

Presentations

Person	Organisation, Position…	Title of the presentation
Dr Jordy Hendrikx	Snow Avalanche Consultant, Dynamic Avalanche Consulting Ltd., Director of the Snow and Avalanche Lab, Montana State University	***ip0179 - evaluation of an avalanche detection network in glacier national park***
Daisuke Shimizu	Guest Research Engineer at National Institute for Land and Infrastructure Management	***ip0128 - system that uses big data to identify passable roads after disasters***
Fabien Menant	Research and Development engineer at Gustave Eiffel	***ip0157 - measurement of the iri in winter condition with a road profilometer inspired by***

Person	Organisation, Position…	Title of the presentation
	University	***probe vehicles techniques***

4. TECHNICAL FINDINGS AND DEBATE

This session has 3 presentations about different source of information related to increasing the resilience of RNO.

The "evaluation of an avalanche detection network in glacier national park" shows an example of how the use of the instrumentation of a site with a network of sensors can be used to detect events and act in the quickest way possible to close and reopen roads. In the discussion, we saw that this technique may possibly be used to detect other "sliding" events.

The two other presentations showed examples of how vehicle probe data can be used to increase road and road system resilience.

The "system that uses big data to identify passable roads after disasters" explain how beneficial the use of well-presented real-time data can be for RNO monitoring, decision making and road user information.

The "measurement of the iri in winter condition with a road profilometer inspired by probe vehicles techniques" shows that it is possible to collect road profile information in winter condition with the right equipment and algorithm.

Title of the presentation	Abstract
ip0179 - evaluation of an avalanche detection network in glacier national park	The Trans-Canada Highway (TCH) runs across the whole of Canada and is a vital link in the nation's transportation network. The TCH through Glacier National Park (GNP) is threatened by 135 avalanche paths causing an average 74 hours of closures per winter and significant risk to highway users. Winter Average Daily Traffic (WADT) increases annually, and without additional mitigation, avalanche risk to highway users, and the frequency and duration of closures, are expected to increase. Parks Canada Agency (PCA) is responsible for assessing avalanche hazard in the transportation corridors and implementing closures and active avalanche control. Accurate real-time avalanche occurrence data is critical in determining avalanche hazard and making decisions on closures and control. Historically, PCA forecasters relied on sight or sound for avalanche observations, which are limited by visibility and staff availability. Under the Federal Infrastructure Investment Program, PCA contracted Wyssen Avalanche Control (WAC) to install an Avalanche Detection Network (ADN) from 2018-2019 which provides remotely sensed real-time avalanche occurrence data. ADN detections assist forecasters in assessing hazard, selecting targets during control, and timing the closures, control and the reopening of the road. The ADN comprises four Doppler radar systems and thirteen infrasound arrays which monitor avalanche paths along ~30km of the TCH through GNP. Doppler radar emits electromagnetic waves which are reflected with a phase shift due to the avalanche velocity, allowing detection of avalanche motion. Infrasound waves are low frequency (<20 Hz) sound waves that travel through the air at the speed of sound (~340 m/s). Infrasound is widely used for the detection of natural and artificial phenomenon, and has recently been applied to avalanche detection.

	The ADN infrasound arrays detect avalanches big enough to bury a car (McClung and Schaerer, 2006)[1]) within a ~3 km radius, while the radar systems detect avalanches in specific paths from distances up to 4 km. Analysis of the detections for 2018-19 and 2019-20 seasons resulted in Probability of Detections (PODs) of 0.39-1, Probability of Non-Events (PONs) of 0.81-1, False Alarm Rate (FAR) of 0-0.19, and Heidke Skill Scores (HSSs) of 0.35-1 for infrasound, and POD of 0.26- 0.96, PON of 0.79-0.96, FAR 0.08-0.44, and HSS of 0.05-0.83 for radar. Despite the early stage of calibration, PCA confirmed the value of these detections in aiding forecaster decision-making. Ongoing improvement in performance of the ADN is being achieved by adjustments to the algorithm based on the data from each season.
ip0128 - system that uses big data to identify passable roads after disasters	In the event of a disaster, it is necessary to provide drivers with road closure information as quickly as possible. In the past, this has been lack of immediacy due to the need to conduct field surveys to determine the locations of non-passable roads. As a result, there has been demand for a system that provides road administrators with real-time information on non-passable roads and traffic restrictions. It is against this backdrop that the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) developed and deployed the system that collects and visualizes traffic records using vehicle's probe data. This system allows users to display traffic records on a map using probe data collected by using road-to-vehicle communications via the network. By displaying the probe data on the map, users can determine all of the sections of roads travelled by vehicles. This enables them to identify passable roads in areas impacted by a major disaster. Furthermore, MLIT is using the system in combination with field surveys to create "Passable Maps." The maps are published on MLIT's website and contain information on passable and non-passable roads during times of disaster. In this presentation, we will give an outline of the system and introduce some case examples of its utilization in road administration.
ip0157 - measurement of the iri in winter condition with a road profilometer inspired by probe vehicles techniques	The Ministry of Transportation of Quebec (MTQ) in Canada is in charge of the management of about 30 000 km road network. Each year, the MTQ evaluates the road network condition by considering several indicators. One of them is the level of road deformation due to the frost which is measured through the International Roughness Index (IRI) annual difference on a same road section using data collected in summer and winter. Measuring the IRI in winter condition is not an easy work: the presence of snow and ice at the road surface, the very low temperature make the use of very accurate road profilometers inappropriate. For this reason, the MTQ measures the IRI with a special equipment (instrumented trailer similar to a bump integrator) during winter campaigns. As this equipment offers several disadvantages for the maintenance and the field application, the MTQ looks out for a new technical solution. In this context, the MTQ has collaborated with the Gustave Eiffel University (France) in order to test a new research prototype of road profilometer (named UniWheel) which aims to be an alternative solution inspired by probe vehicle techniques for the measurement of the IRI in winter condition. This article describes the methodology used for assessing the performance level of UniWheel in comparison to a class 1 profiling device and outlines experimental results coming from field tests.

5. RECOMMENDATIONS FOR DECISION MAKERS, FOR PIARC OR FOR INTERNATIONAL ORGANISATIONS

The implementation of a detection network similar to the one presented in the ADN presentation should be considered as a monitoring solution for major sliding events to reduce the decision time, increase the security of road users and allow a quicker reopening.

The usage of vehicle probe massive data (coming from homemade system, OEM technology or crowd data) should be investigated for specific needs in RNO monitoring both in near real-time application and for planification or analytics purpose.

6. PREPARATION OF THE SESSION

This session was planned, designed and organised as follows.

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