Using a Compact Mobile Profiler and ArcGIS to Measure and Compare Seasonal Road Conditions

Nurahmatjan ABLIZ, Graduate student, Kitami Institute of Technology
Kazuya TOMIYAMA, Assistant Professor, Kitami Institute of Technology
Akira KAWAMURA, Professor, Kitami Institute of Technology

1. Introduction

Pavement roughness relates to qualitative characteristics of the road, the vehicle behaviours, and not only affects the safety and comfort of passengers, but also affects the vehicle operation costs. Firstly, this paper presents the measurement results of IRI (International Roughness Index) during different seasons, and shows comparative road conditions between the dry and snow-covered surfaces, at municipal roads of Kitami city in Hokkaido by using a compact MPM[1)] (Mobile Profilometer). Finally, we shows the digital road map linking IRI and ArcGIS[2)] data to visualize roughness conditions taking road network in the city into for evaluate and find the features of roughness in the road network by using ArcGIS to visualize the measured data.

2. Outline of the Road Roughness Measuring Device in Pavement Monitoring

Pavement roughness measuring system consists of two small accelerometers, a GPS (Global Positioning System) sensor, a transducer and a PC for data processing. Principle of Pavement roughness measuring is very simple. Two accelerometers are mounted on the suspension system of a survey vehicle as shown in distorted **figure1.** After components of resultant acceleration vehicle speed component is removed, IRI is calculated by cumulative vertical deviation at the suspension system in real time, together with positional data from GPS. Moreover, it can be represented on a digital road map using the ArcGIS software. This system can be installed in any passenger cars, so that the road monitoring offers versatile operation for local governments.

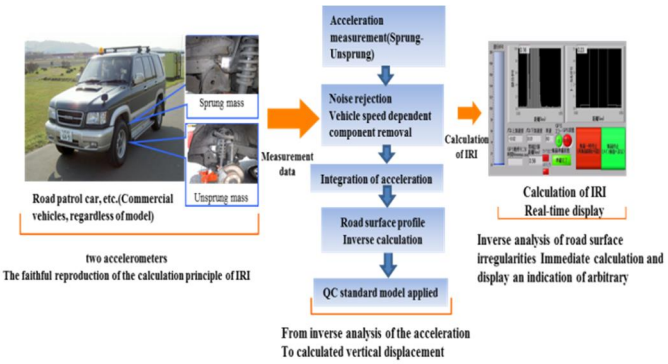

Figure 1 Compact mobile profiler

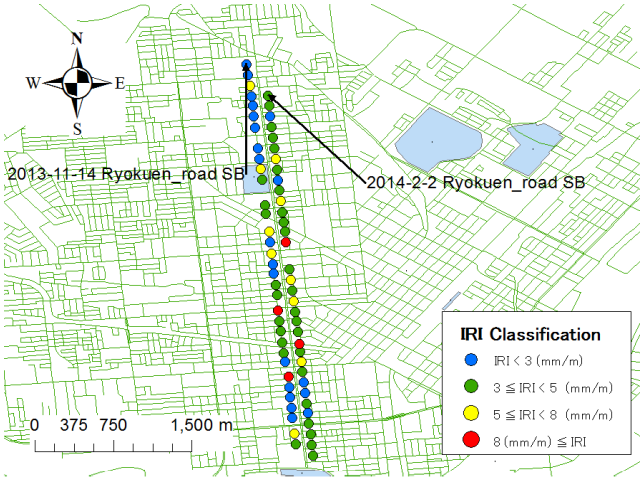

Figure 2 Seasonal change of road roughness in Kitami (SB)

3. Visualization and Analysis of the Measuring results by ArcGIS

To compare and find the differences of these two different seasons, this experiment carried out by using mobile profiler in November 2013 and in February 2014 in population more than 100 thousands core city in Hokkaido region. The IRI data are measured as for each 100m intervals, and shown on digital map using ArcGIS. Figure 2 and 3 shows the results of dry and snow-covered road conditions on a major municipal road, in order to compare and make sure which road conditions are better than other one.

Key words: Uneven road, Vehicle operating cost, IRI, MPM, ArcGIS
Kitami KOENN-CHO 165, Graduate School of Kitami Institute of Technology, TEL0157-26-9516. Hokkaido

In this case, IRI levels are classified, as shown on lower right corner of the Figure 2 and 3.**Figure 2** shows IRI road map for southbound (SB) direction in comparison with seasonal road surfaces. **Figure 3** shows those for northbound (NB), and both seasons measurement can be sure dry road conditions are better than those of snow roads.

4. Statistical Analysis

Figure 4 and **5** show results of histogram and cumulative functions, obtained at municipal roads using the same IRI data for each 100m, and each figures shows the results of road conditions of season. According to histogram and cumulative distribution function (CDF) of southbound directions, the results show that, southbound directionôs dry road condition is better than snow-covered one. According to northbound direction road conditions, using same analysis method to compare seasonal road conditions, the results much clearly shows that, the dry road condition is better than snow one.

5. Conclusions

In this study we use the MPM to measure IRI and results using ArcGIS shows different seasonal road conditions of urban area by comparison and analysis with road conditions, and study which road condition is better than other one taking city road map into. According to the results from statistical analysis, the evenness of dry road conditions are better than those of snow roads. Because, from the figure 2 and 3 the different four IRI classification's points shows, that the value of IRI of dry road surfaces are smaller than snow-covered roads. Figure 4 and 5 show histogram of both seasons, the results shows IRI values of snow-covered road focus on high IRI. These results demonstrate that dry roads conditions are better than snow roads and very useful for evaluating and managing road conditions in winter quantitatively.

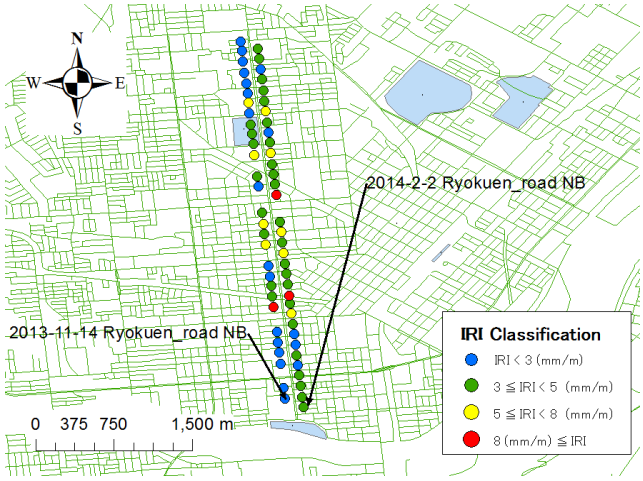

Figure 3 Seasonal change of road roughness in Kitami (NB)

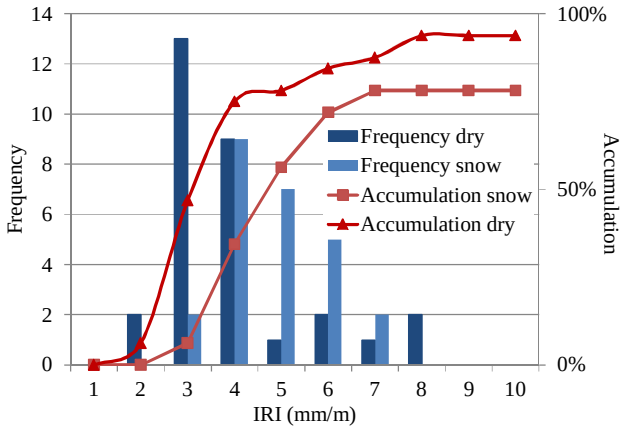

Figure 4 Statistical analysis of roughness in Kitami (SB)

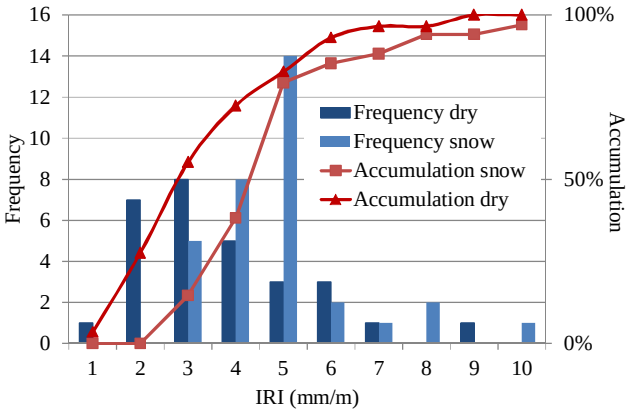

Figure 5 Statistical analysis of roughness in Kitami (NB)

References

1) Tomiyama, K. and Kawamura, A.: Road monitoring of urban road using the mobile profilometer of accelerometer, *Japan Society of Civil Engineers Annual Conference*, Vol.67, V-309, (CD-ROM), 2012 (in Japanese).

2) ESRI Japan Co., Ltd: http://www.esrij.com. 2012.