Can a smartphone collect IRI data?

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Introduction

This paper presents results from a proof of concept study of translating vertical acceleration data recorded by a “smartphone” into International Roughness Index (IRI) values.

Pavement condition data are used by provincial and municipal transportation agencies to determine when and where to repave their roads in order to maximize lifespan and minimize cost.

Currently, these data are typically collected with the use of dedicated instrumented vehicles which are owned by transportation agencies or contracted by municipalities.

In smaller jurisdictions, these data may not be collected at all due to the high perceived cost.

“Smartphones” are devices which in addition to having a phone, allow users to take photos and videos, record their location with Global Positioning Systems (GPS), contain a gyroscope and accelerometer, and connect wirelessly to the internet.

These features make smartphones ideal data collection platforms and while they have seen widespread consumer adoption for communication and entertainment, there has been little scientific evaluation of their capabilities to collect engineering data currently being collected through other proven means.

Objectives

1. Identify existing smartphone applications for pavement data collection and/or sensor data logging.
2. Extract accelerometer information from the smartphone.
3. Translate acceleration data into IRI values.
4. Conduct a controlled lab test to assess the ability of the smartphone to return repeatable results.
5. Use the smartphone to collect IRI values during an on-the-road field test at highway speeds.
6. Compare IRI values from the smartphone to IRI data used in practice.

Methods and Equipment

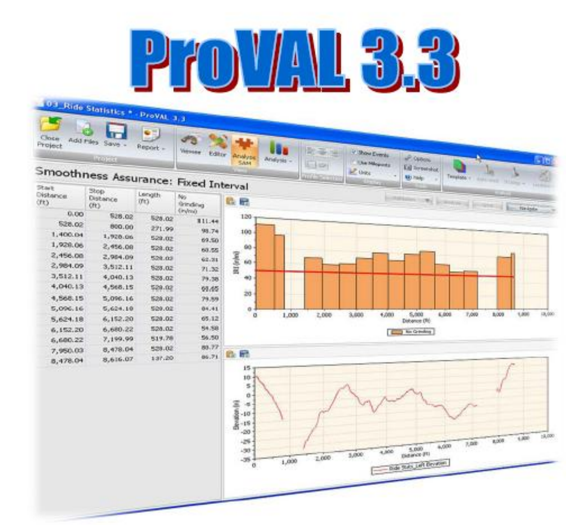
The feasibility study included multiple runs on 2 km (1 km in each direction) of RAD 120 highway near Fredericton.

Data were compared to a dataset of IRI values maintained by the highway operator (MRDC), organized into 100 metre intervals.

The device used to collect data for this study was a first generation Apple iPod Touch equipped with a LIS302DL 3-axis inertial sensor, was mounted in a 2008 Ford F250 Super Duty Truck and operated at a speed of 80 km/h.

Data were only collected for the driving lane.

Apple iPod Touch



Third-party application (app) to log accelerometer data

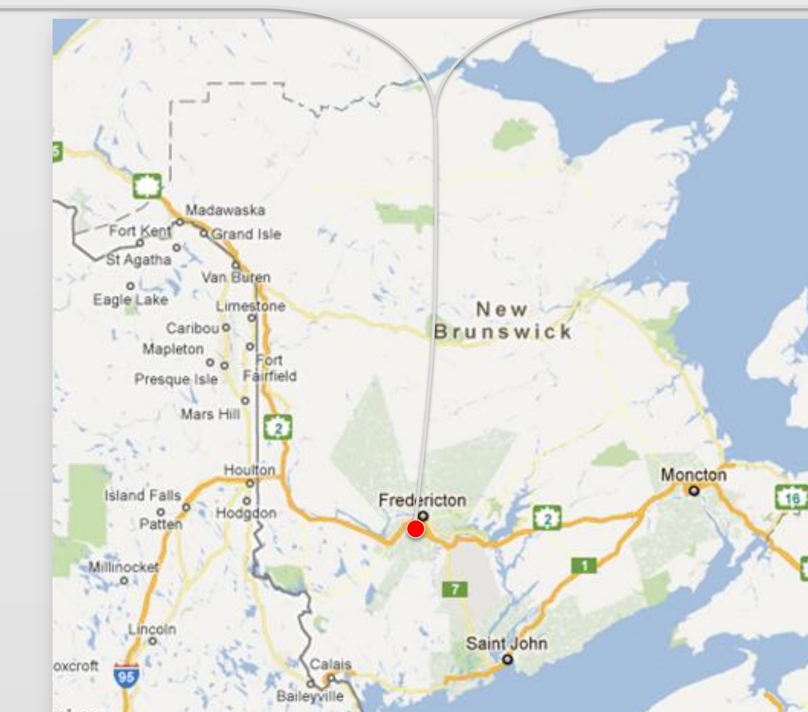
Third-party software to translate acceleration to displacement

Conclusions and Future Directions

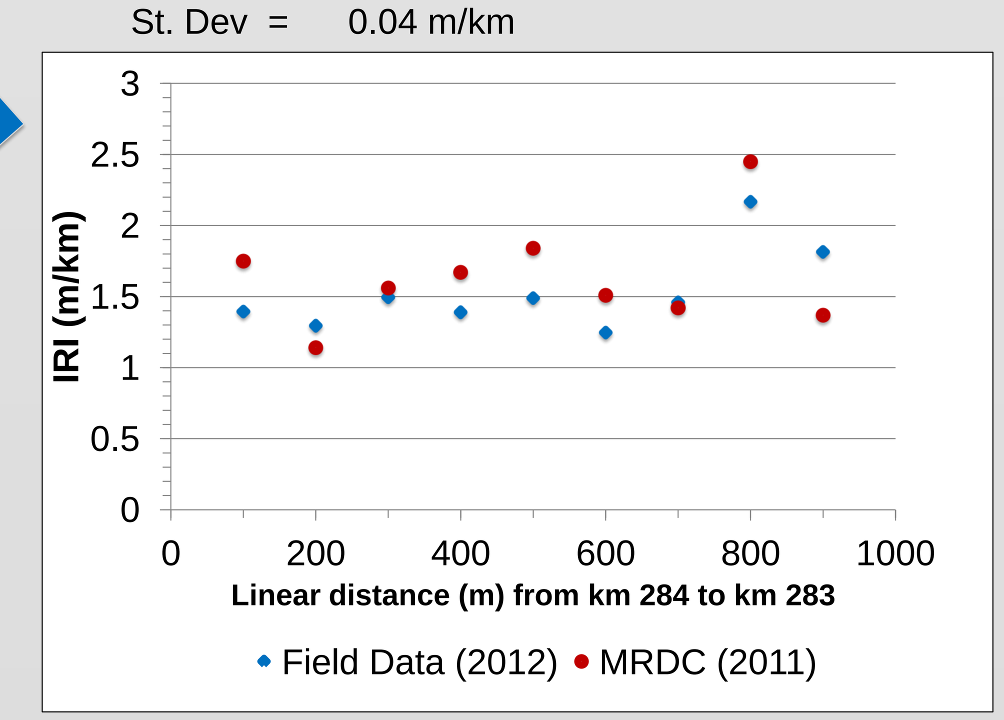
The correlation between the smartphone data and the high speed IRI data appears strong enough to warrant a larger, more in-depth study. It is possible that these values may have an even higher correlation since data for this study were collected nearly 8 months after the high speed IRI data collection.

Results

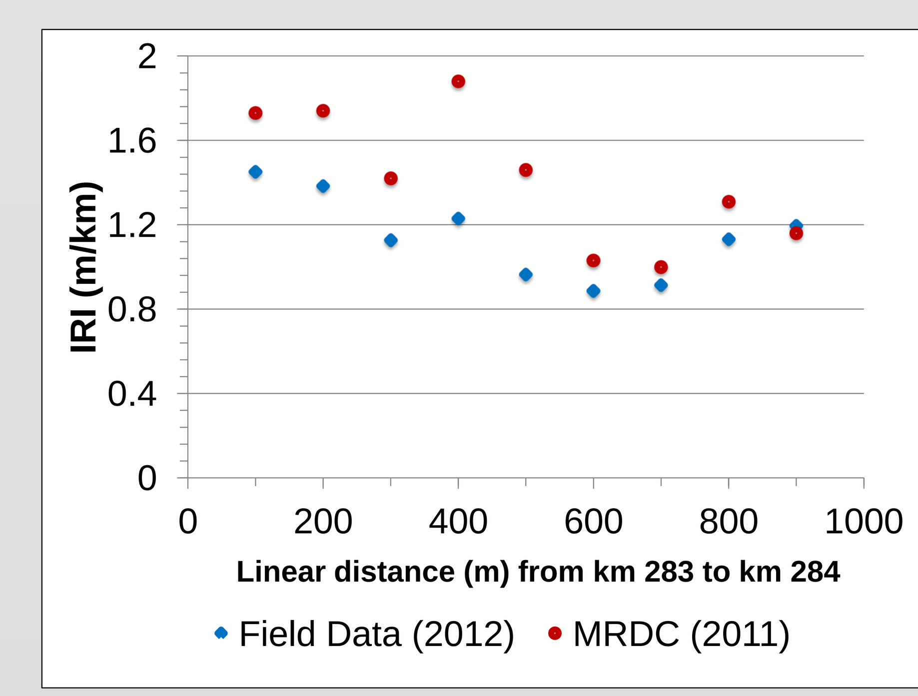
WESTBOUND	
Run	IRI (m/km)
1	1.20
2	1.09
3	1.17
4	1.20
5	1.19
6	1.18
7	1.13
8	1.11
9	1.14
Average =	1.16 m/km
St. Dev =	0.04 m/km



EASTBOUND	
Run	IRI (m/km)
1	1.48
2	1.56
3	1.58
4	1.72
5	1.56
6	1.58
7	1.54
Average =	1.58 m/km
St. Dev =	0.072 m/km



Correlation between UNB/MRDC = 0.767



Correlation between UNB/MRDC = 0.681

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Image sources: Google Maps/Google Images