



**Economical, rapid, and reliable
road condition monitoring
with connected vehicles.**

Protect your roads in real time.

**Improve quality, safety, and
resilience of your road network with
more efficient pavement inspections
and superior data integrity.**

Information Booklet

2024

i-Probe Concept

What is i-Probe?

i-Probe is an innovative pavement inspection system that offers greater road condition monitoring and mapping at a fraction of the time and cost as traditional methods. i-Probe leverages data from sensors pre-installed in late-model production vehicles. Road condition data from our “Custom Inspection Vehicles” is integrated with imaging data and transmitted to a cloud server in real-time allowing users to quickly gain insight into their road conditions. i-Probe can:

- Detect pavement defects even invisible to the naked eye
- Classify type and severity of pavement defects
- Operate up to 70 mph without losing sensor accuracy
- Produce deterioration mapping and custom reporting
- Integrate with certain pavement management systems

i-Probe Advantage

Value of Customized Inspection Vehicles



Superior road network monitoring

Operable up to 70 mph, i-Probe lets you inspect the most expansive road networks viably and with greater frequency.



Consistent and accurate data

i-Probe’s machine detection and algorithms limit human subjectivity and improve data integrity. i-Probe enables you to gain predictive insight through trends in more consistent datasets.



Cost reduction and cost saving

Low upfront and operating costs enable more frequent monitoring. Minimal staff needed. Proactively detect pavement deficiencies *before* advanced deterioration and take preventative action.



Flexible and customizable output

Customizable applications for mapping, database, and reporting. Multi-format exporting of data. To an extent, integration compatibility with various pavement management systems.



Robust data security and privacy

All data collected and transmitted from i-Probe connected vehicles are protected by UTM security and stored in AWS cloud systems. User data undergoes anonymization.



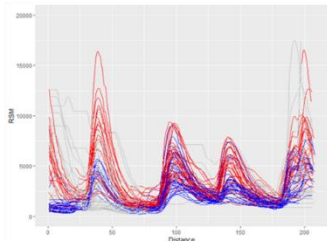
Value-added expert input

i-Probe’s in-house team of maintenance engineers and consultants process data and prepare value-added analysis customized for each user.

i-Probe Advantage

Low upfront and operating cost. High impact.

Factory-installed, existing devices



New devices (for enhanced in-vehicle data monitoring to supplement existing devices)



Laptop computer



Dashboard camera



Handheld interface

i-Probe is an innovative way to carry out road pavement inspection. i-Probe’s “Customized Inspection Vehicles” use pre-existing sensors (in particular, accelerometer) installed in late-model production vehicles. Road condition data is transmitted to a cloud server for processing in real-time.

New devices only include a laptop, dashcam, and interface device which keep upfront, operating, and maintenance costs low. Operation is simple, requiring only one driver.

i-Probe Solution

Industry challenges and constraints

“You cannot manage what you cannot measure” goes a popular saying that underscores the importance of good data. There are various reasons why many road management agencies do not carry out sufficient inspections and data collection. Many share common challenges and constraints. i-Probe offers alternatives and solutions to some of these:

- Cost related**
 - Restrictive budget
 - Only irregular or ad hoc inspection needed/desired
 - Resources prioritized elsewhere
- Inspection Capacity related**
 - Inadequate staff capacity
 - Limited technology / equipment
 - Limited data management / analysis capability
 - Particular inspection needs
- External/Environmental related**
 - Road network too expansive
 - Physically difficult road conditions (weather, terrain, etc.)



- Upfront cost low. Little equipment installation.
- Operating / maintenance costs comparable to common commercial vehicle.
- Customized Inspection Vehicle purchase or lease option available.
- Outsourcing service with skilled staff and appropriate equipment.
- Data processing and analysis service included.
- Scope of service is customizable based on particular needs.
- i-Probe operable up to 70 mph.
- Physical limitation is same as a common commercial vehicle.

i-Probe Innovation

How it works

STEP 1 RAW ROAD CONDITION DATA COLLECTION

Customized Inspection Vehicle captures and transmits road condition raw data and video imagery in real-time.



STEP 2 RAW DATA STORAGE



Raw data is processed, filtered, and securely stored within i-Probe's data repository.



STEP 3 RAW DATA PROCESSING, ANALYSIS, VERIFICATION – ROAD DETERIORATION MAPPING

Unique algorithm is applied to discern pavement distress types and severity. Identified distresses are verified with video records and mapped out. Results are checked and assigned an error probability.

Description	Definition	Example
<i>Pothole:</i>	Potholes found on the wheel path	
<i>Unsound Patch</i>	Patches with cracking of the patching material	
<i>Uneven Patch:</i>	Patched materials are still working but causing uneven surface (bump)	
<i>Soon to be a</i>	Alligator cracks that are likely to penetrate a	



STEP 4 REPORTING



i-Probe transport consultants summarize key findings in report, customized to client's needs including deterioration mapping and predictive inferences.



STEP 5 INFORMED ACTION

Client reviews report findings. Armed with historical and inferential road deterioration data, Client can take informed action.



i-Probe Innovation

Customized Inspection Vehicle in-vehicle interface

Geospatial locator

Imaging feed

RSM time series data

Speed, brake pressure, odometer, RSM*
 *Road Surface Monitoring: pavement roughness condition index

Speed: 10.7 mph
 Brake Pressure: 0 kPa
 RSM: 800
 Trip: 5.848 mile

Record Stop | Setting | EXIT

i-Probe Innovation

Cloud server database – user interface

Snapshot profile of defect (image, geolocation, etc.)

Clicking on each defect listing will open its snapshot profile

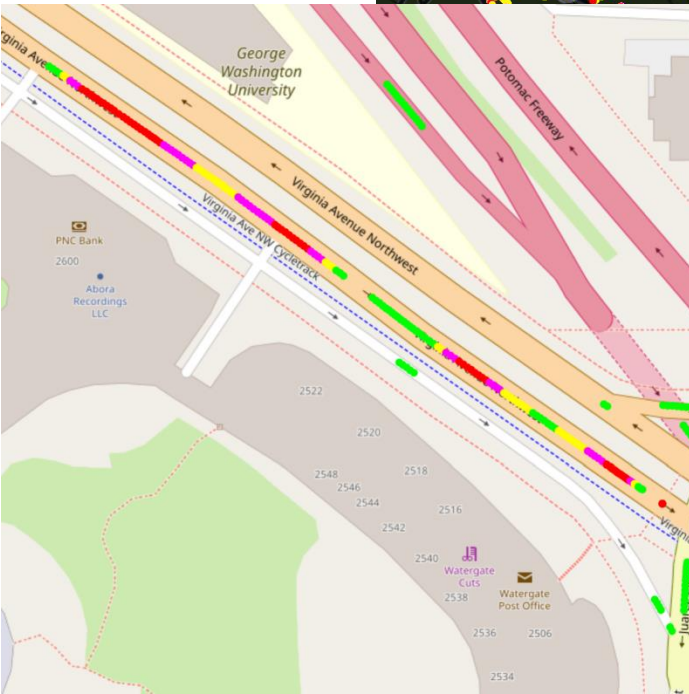
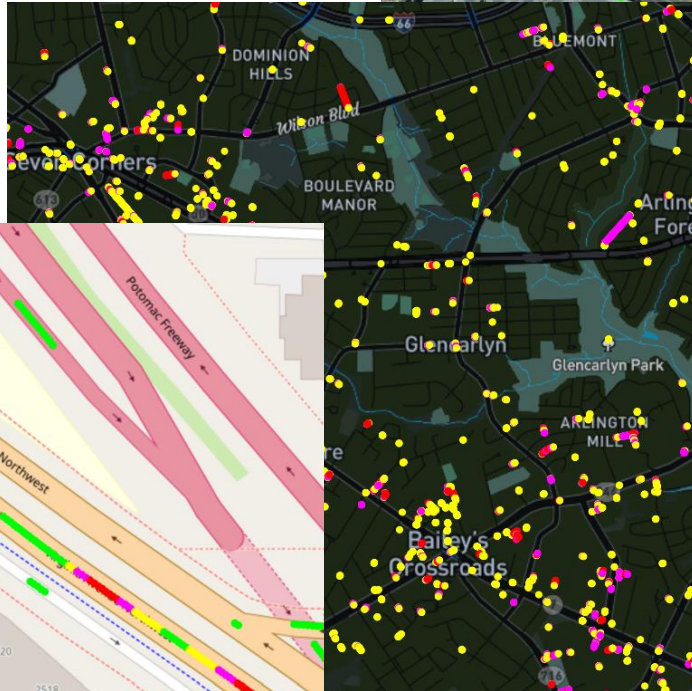
Defect listing includes: road name, direction, post-mile, lane, dates, type of defect

Items	Contents
Route	SR-64
Direction	EB
PM-start	0.4
PM-end	0.5
Lane	
First detected on	
Confirmed on	
Findings	
Updated status	

Direction	PM start	PM end	Lane	First detected on	Confirmed on	Findings	Updated status
EB	9	9.1	C+1	09/19/2022	09/19/2022	Uneven patch(es)	First detected
WB	3.5	3.7	C+2	08/25/2022	08/25/2022	Uneven patch(es)	No data update
EB	1.6	1.7	C+2	07/25/2022	06/25/2022	Pothole	No data update
EB	0.4	0.5	C+1	07/25/2022	06/25/2022	Uneven patch	No data update
EB	1.5	1.6	C+1	07/25/2022	06/25/2022	Pothole	No data update
WB	14.6	14.7	C+2	09/08/2022	09/08/2022	Uneven patch	No data update
WB	15.5	15.6	C+2	09/08/2022	09/08/2022	Unsound approach sl	No data update

i-Probe Innovation

Sample mapping and outputs



No.	PM -Start	PM -End	Lane No.	First detected on	Confirmed on	Findings	Updated status
1	4.2	4.3	1	11/8/2022	11/8/2022	Rough surface	⬆️ First detected
2	12.3	12.4	1	11/8/2022	11/8/2022	Unsound patch	⬆️ First detected
3	23.2	23.3	1	11/8/2022	11/8/2022	Unsound approach slab	⬆️ First detected
4	24.4	24.5	1	11/8/2022	11/8/2022	Unsound patch	⬆️ First detected
5	27.0	27.1	1	11/8/2022	11/8/2022	Pothole	⬆️ First detected
6	40.8	40.9	1	11/8/2022	11/8/2022	Uneven patch	⬆️ First detected
7	41.3	41.4	1	11/8/2022	11/8/2022	Soon to be pothole	⬆️ First detected
8	43.6	43.7	1	11/8/2022	11/8/2022	Soon to be pothole	⬆️ First detected
9	46.1	46.2	1	11/8/2022	11/8/2022	Uneven patch	⬆️ First detected
10	46.8	46.9	1	11/8/2022	11/8/2022	Soon to be pothole	⬆️ First detected

i-Probe Application

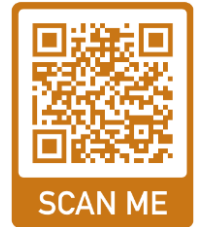
Use cases



i-Probe has just commenced a study to pilot its customized inspection vehicle for the Ohio Department of Transportation. During the study led by Honda and in partnership with academia and the private sector, new technology and capabilities of the inspection vehicles are being developed and tested.



A partnership between i-Probe and HDOT for trialing the capability of its customized inspection vehicles in collecting and analyzing data in a real-world environment, and its instrumentality in supporting HDOT's particular maintenance needs. i-Probe operation was carried out on the islands of Oahu, Hawai'i, and Kauai.



i-Probe Evolution

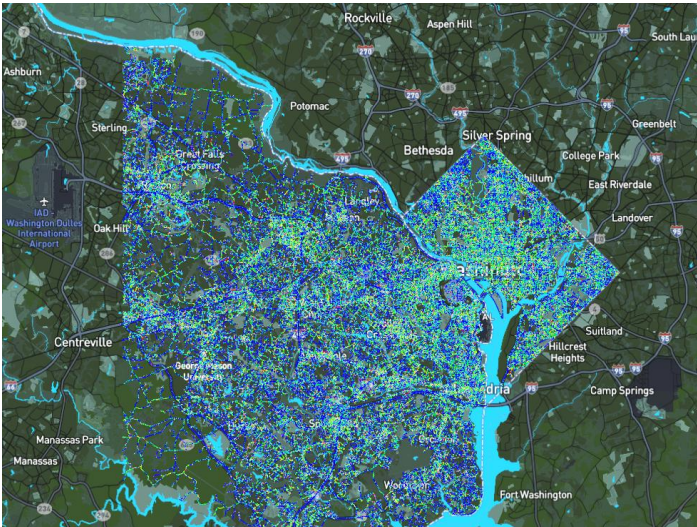
Future of Sustainable Road Maintenance

i-Probe has empowered road agencies to manage their road networks more efficiently with superior data and enabled cost reduction.

What if these feats could be achieved without specialized inspection equipment? Without the costs associated with maintaining and operating such assets? Without a maintenance crew? Year-round in all-weather? What if an entire road network could be mapped instantaneously?

Imagine if road condition monitoring could be done on-demand.

i-Probe, in partnership with Honda Motor Company, applies the power of Big Data to road maintenance. We leverage anonymous data collected from the ever-increasing tens of thousands of connected vehicles on the road today. When applied to our unique algorithms, we can now deliver road condition insights and network mapping to a high degree of accuracy.



Wide-area map of road conditions for Washington DC and Northern Virginia

Be among the first to experience our new Big Data analytics road monitoring service.

Coming in 2024.

Learn more about i-Probe
and request a demo at:
www.i-probe-inc.com



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