Collect IRI by using the built in accelerometer in a modern smartphone.

The Android app registers the vibrations from the road and correlates to the International Roughness Index – and using the phones GPS to position the data. It also monitors Speed and Altitude and use the camera to take GPS-tagged photos. The web service displays the results on accessible internet maps, and with the user log-in you can work with your data.

You save lots of time and increase the quality in ocular road inventory’s. Data is easily collected and transferred to a web service by WiFi. Your road assets are through our log-in globally accessible for yourself but also for your partners: - road owners, contractors, consultants and sponsors.

- Roadroid is easy to use and highly portable way to collect objective roughness data data
- It monitors data and makes instant reports on a map - click thumbnails to view photos.
- Download your files and create IRI-charts in 100 meter segments.
- Use a road database to generate automatic road condition change reports – as continuous follow ups on KPI:s in Performance Based Contracts.

Roadroid is globally awarded Innovation from Sweden
Quick start guide

Use a Samsung Galaxy S2, S2+, S3 or Note/Note2 with OS 4.x and download the installation file at www.roadroid.com/app/roadroid.apk. OBSERVE: We need you phones IMEI-number to allow import of data. Data from where we have applied an Open Street Map-road network we be visible on the public view. You need a user account to the user toolbox and work with your data.

- Mount the phone car rack in the front window. Make sure you have a stable bracket, the original Samsung devices are good. Fit it so it is easy to reach and tap on the display.

- Mount the phone as straight (vertically or horizontally) as possible. Adjust the rack so that the camera display the road (Tip - use the android cam to find a suitable angle).

Start the Roadroid application, and press "Ok" in the display settings box. Make sure to choose the correct phone and vehicle type. Use the Android menu button down left to open Roadroid settings. Choose “Android Device” to choose phone and “Vehicle Type” to choose:

a) Small car/business van as Renault Kangoo
b) Medium/big sedan/station wagon or estate as = Volvo v70
c) 4WD jeep type = as Toyota Hilux or Nissan King Cab

Use standard cars: Avoid mini-cars, sport suspension, unbalanced or low profile tires etc.

Back in the app - Press the yellow “calibrate” button. Set the X, Y and Z as close to = 0 as possible by adjusting the bracket in the right position.

Loose the bracket screw to make the rough setting and tighten it to tune. Go back from calibration mode with androids “back” button.

Press “Start/stop sampling” (the button turns red).

Measurement starts now if the GPS signal is available (stand still to receive a GPS-signal and this may take a minute for some locations). Sampling requires a speed between 20 - 100 km/h (Tip: Pass speed bumps below 20 km/h).

When measurement is complete, press again the Start/stop sampling again to stop measurement. (Tip: Note date and time if you want to keep track of your saved files).

Use “Add bump” if you miss a bump (e.g. passing a pot hole between the wheels) and “ Rem. Bump” to remove 5 sec of the last measurements (if you accidently record something you not want to save).

To take GPS-photos – simply touch the colored scale/bar that positioned under the Display Map.
Introduction

Roadroid (PAT. PENDING) is a Swedish innovation developed since 2002, initially using accelerometer, GPS and a laptop PC - to now using the built in accelerometer in a smartphone.

Roadroid support different cars, speeds and phone models. Extensive field trials and research has been performed and over 10 million samples is collected globally. Roadroid use modern technology and the highest knowledge in Android programming and global mapping services. Our system and services will continuously develop.

Roadroid method of analyzing the vibration data and estimating an IRI (eIRI) takes into account the current speed, vehicle type and phone model. The correlation was originally developed towards Swedish IRI measurements collected by laser beam.

Roadroid is a modern, easy and cost efficient way for road roughness data collection!

- You do not need a special built wagon or vehicle!
  - Only a standard car and a standard smartphone!

The Roadroid app is using the smartphones built in accelerometer to analyze the road vibrations and its GPS to position the data!

- Data collection can be done by driver – there is no need of a specific operator (saves money).
- The possibility of collecting data continually opens new perspectives performance monitoring. Roughness changes can be monitored on daily, weekly or monthly basis.
- Roadroid is a global system, easily accessing remote areas to collect objective data.
- Roadroid saves IRI values with Long/Lat position, Altitude and Vehicle speed each second.
  - Data is presented on an internet GIS tool and you can extract 100 meter sections of the data.
  - Accept from the roughness data, vertical road profile and speed profile can be mapped.

You do not need a complex calibration procedure, and the app has a setting for three type vehicles. The correlation of the estimated IRI (eIRI) towards laser beam measured IRI is about 70-80% - depending on road surface type. The accuracy can be increased with some tuning, and the IRI sampling is currently developed with a calculated IRI (cIRI) - to enhance the correlation factor.

Roadroid use the phones built in camera to snap GPS-tagged photos that can be transferred to the map tool and shown as clickable thumbnails to view the taken photos.

Roadroid also have a separate road inventory application to be used for ocular inspections. This app saves manual input of standard road inventory parameters as rutting, cracks etc in an efficient way. Instead of using pen and paper you simply add the occurrence of each parameter while inspecting and the data is saved with position data to be viewed on the web maps.

Roadroid has also been used together with a stand-alone HD-Video camera with GPS tracking. There are well functioning GPS-Video cameras on the market, using the same background maps. So instead of using the possibility to use the phones video function is better to use this stand-alone solution.
User cases
Roadroid have identified roughly two rough user cases. It can be seen as market segmentation with a bit different value propositions for each segment:

A) Developed road networks - Running maintenance and Performance based contracting.  
B) Developing road networks - Gravel roads / road inventories / inception reports .

Developed road networks
To be a good support for developed roads/streets and in performance based contracting Roadroid needs an access to a well-defined road database. Roadroid can also feed different asset management softwares with IRI-values.

In this user case, Roadroid should be used in a continuous data collection. Here suitable probes (data collectors) could for instance be:
- the contractors personnel - likely doing ocular/subjective inspections
- the asset owner for control
- third partys, as consultants
- the cars delivering newspaper for the rural areas in the morning. They drive all roads where there are people, and likely most roads of interest at least 6 times per week. They have the same route every day - preferably for data aggregation.

We do no aim to use crowd sourcing, as it would generate more data then needed (roughness does not change that dynamic). It would also raise a lots of support and quality issues to deal with. One step towards a more public contribution could be dedicated nomads as road/car interest groups.

Continuous data collection will enable monthly Road condition change reports, with a trend indicator to monitor roughness development over time. The information can directly guide pot-hole fixing and urgent patching. The data can also be given as a dynamic feed to your asset management system or road maintenance management system.

Roadroid can work as an early warning system; -to see when and where a road is changing state and can be an important input for preventive measures and fixes. And we do have specific reports for this purpose – se chapter 2.
In winter road maintenance a daily (or event initiated) input can give input to grader operations, or follow up quality of plowing operations. In spring times, with frost heave and thaw Roadroid can monitor day to day roughness changes and can guide load restrictions. You can clearly see when and where the problems occur. Heat buckles can be another opposite area of interest.

As the data is seamlessly distributed to a web service, it opens up for ITS and road user services. In a first phase Roadroid can work as a guide for the contractor to place road side bump signs.

But it would actually be fully possible to distribute *digital bump signs* using a location based service protocol to navigators.

A potential is also to alert and guide actions with accurate laser scanner measurement. Roadroid can give you early warnings that something is happpening with the roughness, and to find out more about what exactly is happening you can direct when and where to a detailed but expensive laser scanning.

Roadroid works as a stand-alone IRI sampling system, you can do it regularly at comparably very low costs and it’s a great advantage to a subjective and visual roughness assessment.

**Developing road networks and unpaved roads**

Here Roadroid helps to solve slightly different pains; -as it might be the only alternative to perform a repetitive and objective roughness *measurement*.

You can easily bring the technology to remote areas in developing countries, war zones, islands or at unpaved roads far from where a laser scanner equipment will ever be able to go. Roadroid is easy to operate and works in any vehicle without expensive repairs or maintenance.

Above data is shown from Afganistan, southwest of Masar Al-sharif, collected by UN Ops. IRI data is delivered in 100 meter linkage in .txt files for import to excel.
The app - an overview

Sampling Start time
Will the file name and could be used for notes of place etc.

Calibration
Ensure that the phone is vertically mounted (see instruction)

Display map
Can only be used with WiFi/3G Shows map and black spots

Estimated IRI
Second resolution vibration data (it is not the mm/100m)

Speed Indicator
eIRI is sampling between 20-100 km/h in default setting.

Add Bump
Adds a bump in actual position Use if drive over pothole

GPS-indicator
Green – OK/Red - No contact

Cart type setting
Small / Medium-Large / Jeep

Vertical Calibration
Green – Ready to sample Yellow – not calibrated

Start/Stop sampling
Grey – Not sampling Red – Sampling

Classification level
Color indicator from Good, Satisfactory, Unsatisfactory and Poor (Green, Yellow, Red, Black).

Remove Bump
Removes 5 sec of data Use if wrong registration

System GPS indicator
Steady – OK/ Blinking N/A

Calibration
Ensure that the phone is vertically mounted (see instruction)

Estimated IRI
Second resolution vibration data (it is not the mm/100m)

RMS - Root Mean Square will be replaced with cRIL

Speed
If between 20-100 km/h

Battery Indicator
Try always to run with power adapter

Sampling rate
How many readings in second loop analysis.

GPS Accuracy
Should be 5-10 m

Long/Lat coordinates

[0.92]
Low speed!
Add bump Rem. bump

[6.66]
Add bump Rem. bump