Toward future-Oriented Road Surface Monitoring

Ministry of Land, Infrastructure, Transport and Tourism New Technology Information System
NETIS
Registration No : KK-210066-A

ACTUS

Wireless IRI Measuring System

【Advanced Compact Telecommunication Unwired-accelerometer System】

The Simple, Convenient, and Accurate IRI measurement

- ☆*Simply press Start and Stop to take IRI measurements*
- ☆*Easy to install, even on passenger vehicles*
- ☆*Enjoy more accurate monitoring with a structure based solely on IRI principles*
- ☆*Quickly evaluate road surfaces with real-time monitoring*
- ☆*Obtain positional information even in tunnels and other places Where no satellite signals are received*

ACTUS (a simple IRI measurement system)

- The International Roughness Index (IRI) was proposed in 1986 by the World Bank as a metric for linking pavement performance to motorist comfort.
- Japan has required the use of IRI to evaluate the longitudinal roughness of road surfaces since the February 2013 publishing of the Sotenken jisshi yoryo (an) hoso hen (The Implementation guideline on general inspections(proposed)for pavement).

ACTUS is a simple IRI measurement system that makes it possible to obtain data about road surfaces from regular vehicles wirelessly and while in motion from sensors installed on the vehicles. We can expect this technology to enable data acquisition at high frequencies, improve economic efficiency and workability, shorten work schedules, and limit negative impacts on the global environment.

Remarks

①ACTUS was jointly developed by the Kitami Institute of Technology, Tokyo University of Agriculture, PROFICT LAB Co., Ltd., Kotobuki Engineering Co., Ltd., and NEWJEC Inc.
②ACTUS was part of an event for matching needs to technology seeds hosted by the Kinki Regional Development Bureau of the Ministry of Land, Infrastructure, Transport and Tourism.
③An industry-academia consortium was launched for the Mobile ProfiloMeter (MPM) pilot project.

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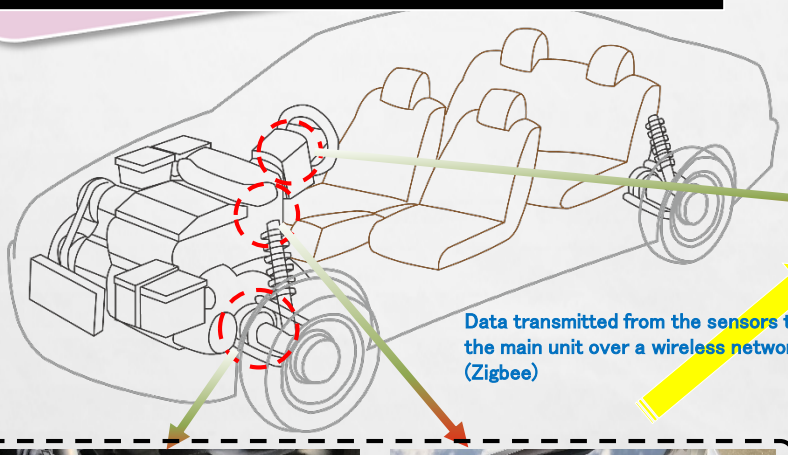
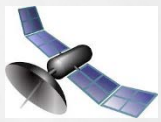
◆Key Features

- ●Acceleration sensors mounted on sprung mass and on unsprang mass of vehicle send data wirelessly to the main unit (no need to connect the sensors to the interior)
- ●Obtains positional information from GPS and vehicle speed pulses
- ●Sensors extract vehicle speed pulses and relay them to the main unit, making it possible to obtain positional information inside tunnels and other places where no satellite signals are received
- ●Enables real-time monitoring from computers by combining road surface data with positional information
- ●Plots measurements on maps and drawings

◆System configuration (Installation locations)

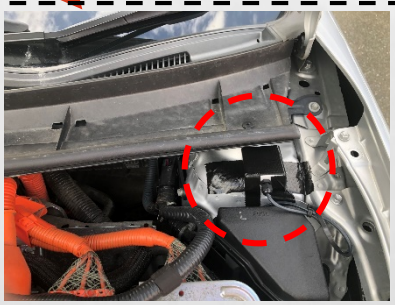




GPSantenna

＊Laptop or tablet (separate preparation required)

Installation location of lower sensor



Installation location of upper sensor

＊Acceleration sensors can source their electric power from dry batteries or by connecting to the vehicle battery.

ACTUS main unit
(with built-in gyrosensor)

An acceleration sensor
(5-cm opening, 2 cm thick)

ACTUS main unit

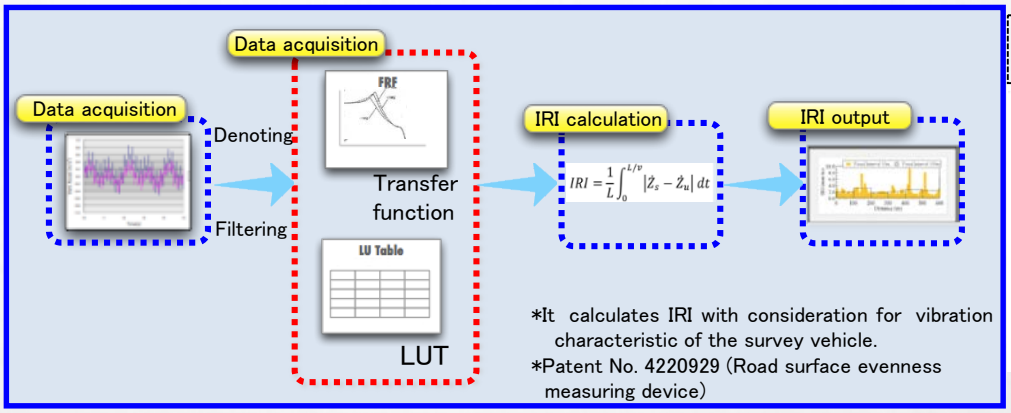
- ・Built-in gyrosensor
- ・Built-in wireless module (IEEE802.15.4: Zigbee)
- ・Built-in GPS module (GV-87 evaluation kit)

Acceleration sensors

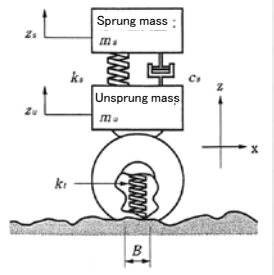
- ・Built-in wireless module (IEEE802.15.4: Zigbee)
- ・Acceleration sensor ADXL345 (triaxial) Frequency: 800 Hz

*If requested, we install and calibrate the equipment (consultation required).

◆Measurement principle (transfer function method)



Quarter-Car (QC) Simulation



◆Performance

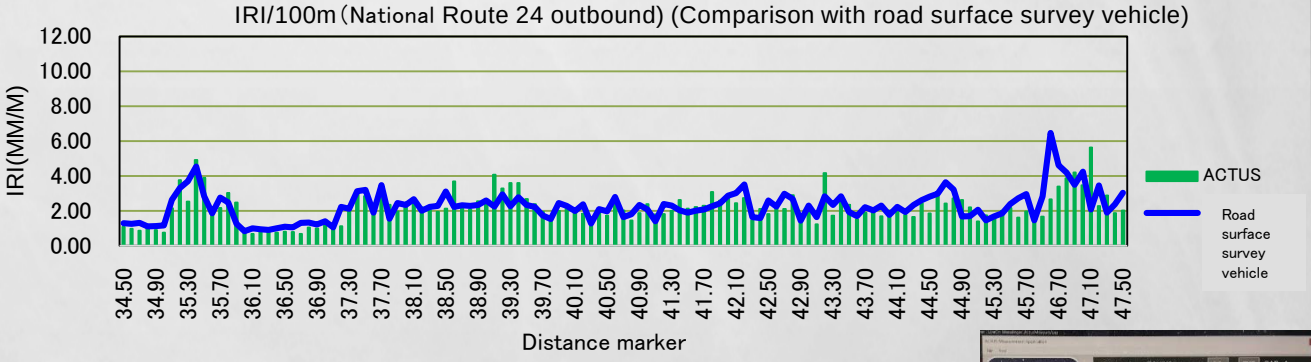
Demonstrates Class-2 performance as described in the Pavement Survey/Test Method Manual (2019 version).

Class	Method of measuring surface roughness	IRI calculation method	Method of application
1	Rod and Level measurement	IRI is calculated based on QC simulations after measuring longitudinal roughness with a level or the like	Measurement
2	Laser displacement sensor	IRI is calculated based on QC simulations after measuring longitudinal roughness with a laser displacement sensor	Road surface survey vehicle
	Accelerometers mounted on sprung Mass and unsprang mass	IRI is calculated with sprung/unsprung mass accelerometers in the course of transfer function correction based on IRI principles (QC simulation)	ACTUS
3	Response-type road roughness meter	An arbitrary roughness index based on acceleration is measured and converted to IRI using a correlation equation	Smartphone, etc.
4	Physical sensations and visual confirmation by surveyors riding in patrol cars or the like	IRI is presumed and quantified based on ride experience and visual inspection on patrol cars	Physical sensations, visual confirmation

◆Quality of measurement

ACTUS was part of an event for matching needs to technology seeds hosted by the Kinki Regional Development Bureau of the Ministry of Land, Infrastructure, Transport and Tourism in 2020, where it was compared to the road surface survey vehicle used in regular road surface inspections, and performed favorably in terms of economic efficiency, work processes, quality of the final results, safety, and workability.

IRI/100m (National Route 24 outbound) (Comparison with road surface survey vehicle)



ACTUS and the road surface survey vehicle in simultaneous operation for the comparison

●Computer screen for measurements
Displays positional information, speed IRI, time, and more

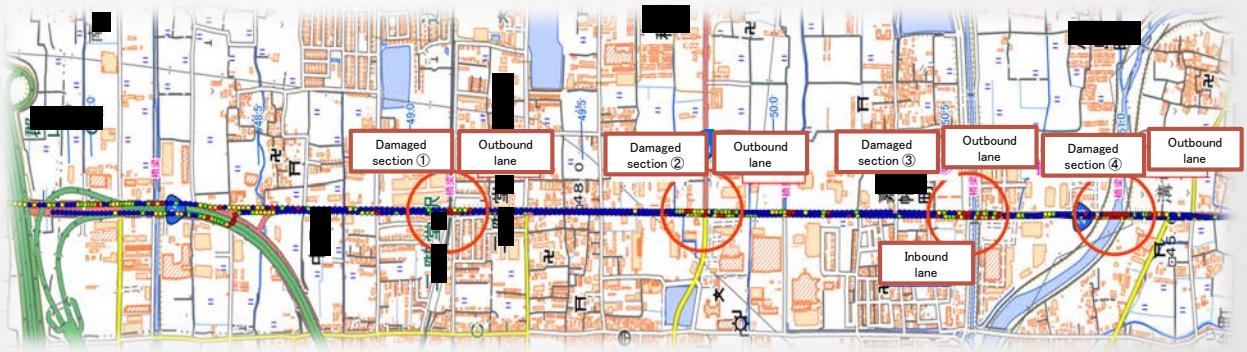
●IRI measurement error for ACTUS and the road surface survey vehicle

Type	Equipment	Mean IRI/100 m	Mean speed	Error
Inbound	ACTUS	2.13	39.6km/h	0.99
	Road surface survey vehicle	2.15	–	–
Outbound	ACTUS	2.17	43.7km/h	0.96
	Road surface survey vehicle	2.27	–	–

◆Options

・Plotting IRI measurements on maps:

⇒The system uses GIS to plot measurements on maps for identification of damaged section.



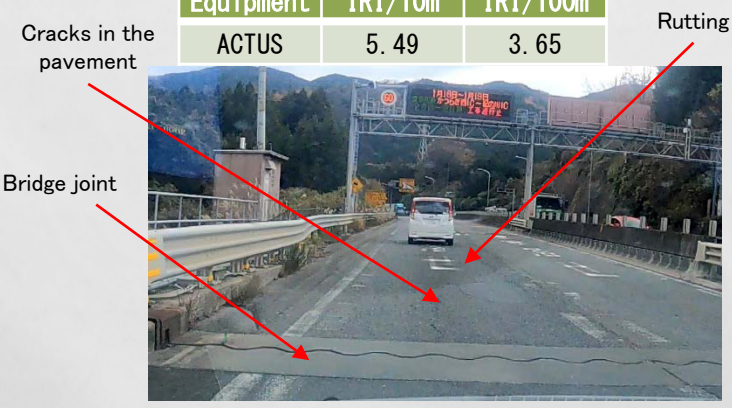
◆Product specification

Measurement ranges	Speed rage: 20 to 120 km/h ,Public roads, Operating temperature range: −20 to +85° C	
System requirements	OS: Windows 8/10 (64−bit), Memory: At least 4 GB	
Sensor power source	Dry batteries	Three AA batteries (Battery life: Approximately 20 hours/Type: Alkaline)
	Vehicle battery	Power cable that connects to vehicle battery
Equipment and accessories	Main measuring unit, acceleration sensors (2), external battery box, power cable for connecting to vehicle battery, USB cable, point recording device, vehicle speed signal cable, GPS antenna, CD−ROM (driver), instruction manual	

◆Using action cameras to verify the condition of road surfaces

・Installing an action camera (e.g. GoPro) separate from the system and taking simultaneous measurements makes it possible to verify the consistency of ACTUS results with the condition of road surfaces.

Equipment	IRI/10m	IRI/100m
ACTUS	5.49	3.65



Photograph of the condition of the road surface

Camera position

◆Contact for inquiries

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Technology in harmony with Nature and People
NEWJEC

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