Web Page for Confirming Road Surface Measurement Data

BumpRecorder Web

Instruction Manual

2025.8.18

BumpRecorder Co. Ltd.

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1. Preparation

1.1. At first

BumpRecorder consists of three components:

- **BumpRecorder APP** : Road Condition Measurement App for Android Smartphones
- **AtomicBump** : Fully automatic measurement terminal
- **BumpRecorder Web** : Website for confirming measurement results

This manual explains how to operate BumpRecorder Web.

Please access the following address with your computer browser.

https://map.bumprecorder.com/

*For BumpRecorder App and AtomicBump, please refer to their respective instruction manuals.

1.2. About ID

You can use the BumpRecorder App/Web without an ID, but if you register your ID, you will be able to view and download only your data.

User ID types and overview

User ID	Web Display and Functions	Download	Usage fee
NO ID	**Open to others** Some functional limitations	Can not download data	free
Free ID	**Open to others** Some functional limitations	Pay by use	free
Metered ID	Only your own group (**private**) Some functional limitations	Pay by use	Annual Contract
Flat-rate ID	Only your own group (**private**) Full functions available (Optional functions are not included)	Included in the contract cost	More than 3 months

- You can get a free ID from the BumpRecorder Web screen (explained in the next section).
- Metered IDs and flat-rate IDs are collectively referred to as "group IDs" or "paid IDs".
- Please contact us to obtain a group ID (contract).
- You can set a user ID for a group (local government or company).

1.2.1. Get a free ID

Access the following URL in a computer browser.

https://map.bumprecorder.com

エラー! 参照元が見つかりません。 When a screen like this one opens, press the "Get Free ID" button in the upper right corner of the screen.

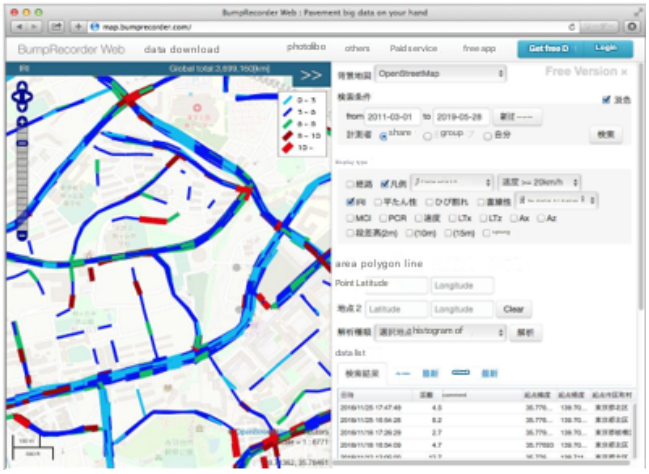


Figure 1-1 BumpRecorder Web Initial Screen

エラー! 参照元が見つかりません。 When the user registration screen opens, enter your username and password, and press the "Register" button.

If the ID is already in use, you cannot register the ID. Please register under a different name.

There is no monthly or annual usage fee for the free ID, and it is free to browse the map screen and download the measurement data (GPS, acceleration data).

Downloads of analysis data, such as IRI, will be charged through PayPal or credit card payment at the time of download

*This is not PayPay.

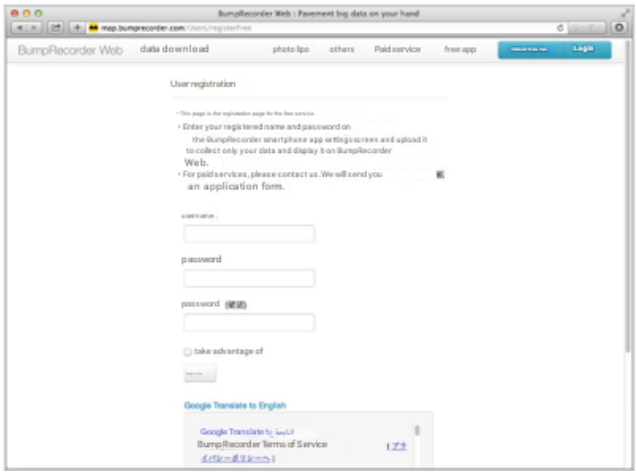


Figure 1- 2 User registration screen

1.2.2. Get a Group ID

Group IDs include pay-as-you-go IDs (annual contracts) and flat-rate IDs (monthly contracts for 3 months or more). Please contact us for a contract. After signing the contract, we will set up a group exclusively for your company and contact you with a paid ID registration URL dedicated to your company. The paid ID registration screen is almost the same as the one shown in figure 1-2. If the ID you tried to register has already been registered (including free IDs), you will not be able to register. Please register under a different name. The data will be private, and only those who log in with the ID obtained with your company's exclusive URL can view the data. You can also download analysis data such as IRI. (Depending on the contract details, you may be charged on a case-by-case basis.)

1.2.3. Login

Press the "Login" button in the upper right corner of **BumpRecorder Web** and enter your ID and password to change to the paid version screen.

2. Basics (data viewing, map screen)

Both free and paid IDs are available.

2.1. Screen Name

The first screen you open when you access **BumpRecorder Web** is called the "**Map Screen**". The map screen is broadly divided into three parts.

Illustration 21 BumpRecorder Web screen

- **Top menu**

  This is a link to a function other than the map screen.

- **Map**

  Here you will see the measurement results.

- **Panel**

  Choose the time period and type of data you want to display. You can close or open the panel by pressing ">>" in the upper right corner of the map.

2.2. Language Switching

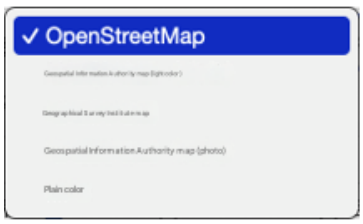
On the far right of the top menu, you will see [ENG] or [Day].

If the current panel is displayed in English, click [Day] to switch to Japanese.

If the current panel is displayed in Japanese, click ENG to switch to English.

2.3. Panel operation

2.3.1. Background Map



You can choose from the map below.

- OpenStreetMap (default)

  Use this when viewing overseas data.

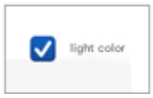
- GSI Map

  If you want to view data in Japan, the GSI map is also useful. The standard "GSI Map" is dark in color, so if it is difficult to see the color-coded display of data, "GSI Map (Light Color)" is easy to see. If you set it to "GSI map (photo)", an aerial photo will be displayed. There will be no location display, but you can imagine what kind of place it is.

・Plain color

This is used when you want to display only the data without a background map. However, with OpenStreetMap you can zoom in even more than GSI maps.

• Light color: Checkbox (default ON)



To the right of the Background Map select box (or Display Type, to be exact) is a Light checkbox.

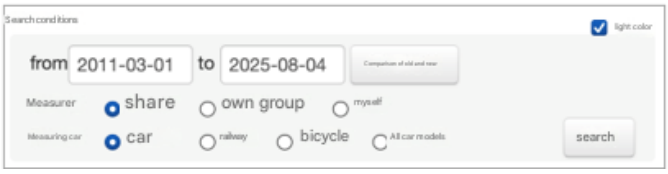
Check ON : The color of the background map is lightened.

Check OFF : The color of the background map is displayed at the original intensity.

It is easier to see if you turn it on when viewing data and OFF when viewing maps.

2.3.2. Search Criteria

After changing the following conditions, press the "Search" button in the lower right corner. The display does not change unless you press the "Search" button.



・from / to

You can select a date by clicking on the part where the date is displayed.

Displays the data from <= measurement start date and time (file name of the data) <= to.

If you set from = to, the data for that day will be displayed.

・Comparison of old and new: button

Please refer to the application section.

・Measured

You can choose from the following:

・Share :View public data uploaded without ID or with a free ID.

・Own group : View data for your group with paid ID.

・Self : View data uploaded with your user ID with a paid ID.

・Measuring vehicle

You can choose from cars, railways, bicycles, and all vehicle types.

In the case of paid IDs, the data is usually registered in "Automobile". If you sign a contract for railway, use or bicycle use, you will be registered for railway and bicycle. In the case of a free ID, it will be automatically determined during the calculation of road surface characteristics after uploading.

・Measuring vehicle

You can choose from cars, railways, bicycles, and all vehicle types.

In the case of paid IDs, the data is usually registered in "Automobile". If you sign a contract for railway use or bicycle use, you will be registered for railway and bicycle.

In the case of a free ID, it will be automatically determined during the calculation of road surface characteristics after uploading.

・Data list

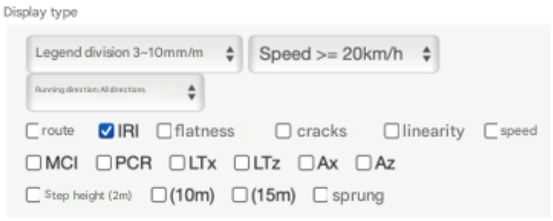
When you specify the above search conditions and press the "Search" button, the data in the range displayed on the map is displayed in the "Data List" at the bottom of the panel in the order of the newest.

2.3.3. Display Type

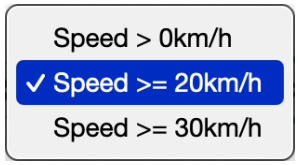
The display changes even if you don't press the "Search" button.

・Precedent category: Select box

Data defined for intervals, such as IRI, are color-coded by value. You can change how many values are displayed in what color.



・Speed: Select Box



The measurement accuracy with **BumpRecorder** is worse below 20 km/h. Therefore, by default, it is displayed at 20 km/h or more.

Speed > 0km/h : Displays all calculated data. Used when you want to prevent missing measurements even if variations increase.

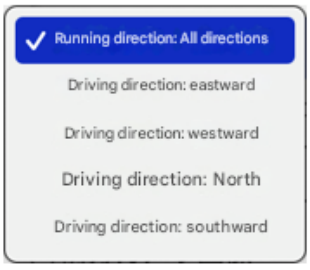
Speed ≧ 20km/h : Displays data with an average speed of 20 km/h or more in a section.

Speed ≧ 30km/h : Displays data with an average speed of 30 km/h or more in a section. Use when you want to display only data with less variation.

*The upper speed limit depends on the acceleration sampling frequency of the smartphone used for measurement. If it is 200 Hz or more, there is no problem even if the driving speed is 120 km/h.

・Travel direction: Select box

BumpRecorder does not use kilopost definitions to determine intervals for interval definition indicators such as IRI. Therefore, the up or down direction is unknown. Instead, by selecting the driving direction, the upper and lower lines can be displayed separately.



Travel direction: All directions displays everything regardless of the driving direction.

Travel direction: East displays data where the end point is east of the starting point.

Travel direction: West displays data where the end point is west of the starting point.

Travel direction: North facing displays data where the end point is north of the starting point.

Travel direction: South facing displays data where the end point is south of the starting point.

*NB The starting and ending points are for each calculated section such as IRI (for example, every 20 meters). It is not the beginning or end point of the entire route. If you are running from southwest to northeast, you will see it facing east and north, and not west and north.

・Indicator Selection: Checkbox (but radio button operation)

You can select one type of section definition indicator and one point definition indicator and a route.

Course

Displays GPS information in a line. All are displayed regardless of the selection in the select box in the direction of travel. Both segment-defined and point-defined indicators are brown if not selected, and gray if either is selected.

Interval Definition Indicators

Like IRI, it is a metric that defines a single evaluation value for the section from here to there (e.g. about 20 meters) and is displayed on the BumpRecorder Web map as a color-coded line. IRI, Planus σ, Cracking, Linearity σ, Velocity, MCI, PCR, LTx, LTz, Ax, Az, Local Deformation, horizontal G, is the interval definition indicator.

*For the meaning of each indicator, please refer to "4.1.1 Interval Definition Indicators".

Location Definition Metrics

This is an indicator defined in "This Location" and is displayed on the BumpRecorder Web map as a size triangle.

Step height (2m), (10m), (15m), and spring are the point-defining indicators.

*For the meaning of each indicator, please refer to "4.1.2 Point Definition Indicators".

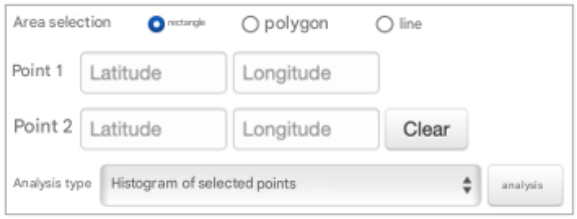
3. Basics (Graph Display)

This is a feature of paid IDs. Not available with a free ID.

First, select an area on the map, then display the graph.

3.1. Area selection

There are three types of area selection methods: Rectangle, Polygon, and Line.



3.1.1. Rectangular Selection (2 Point Selection)

This is a method of selecting a rectangular area with two clicked points on the map as diagonal points. The latitude and longitude of the point you clicked on the map are displayed in the Latitude and Longitude columns of the Point 1 panel. Point 1 in the panel shows the latitude and longitude of the point you clicked before and Point 2 shows the latitude and longitude of the point you clicked before that. On the right, the straight-line distance between two points is displayed, such as "Distance=205m". However, since it is not a large circle distance, it is an approximate estimate, so the error is large at long distances.

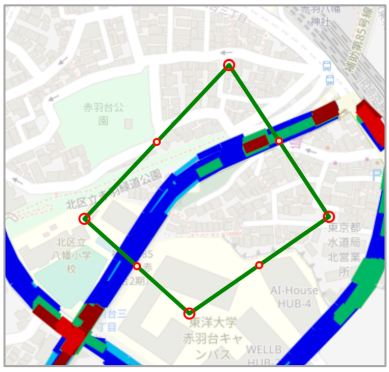
You can also enter it directly in the Latitude and Longitude fields at point 1. You cannot enter point 2 directly, but you can specify a numerical value for both point 1 and point 2 by entering it in point 1, clicking on the map, and directly entering and modifying the Latitude and Longitude fields of point 1 in the panel.

Press the "Clear" button to deselect it.

3.1.2. Polygon Selection (Polygon Selection)

Click on three or more points on the map to select a polygonal area with that as the apex.

Double-click on the last vertex to complete the polygon drawing. When you press the "Correct" button, a slightly larger red circle appears at the top of the polygon drawn on the map, and a slightly smaller red circle appears in the center of the polygon's edge.



- You can change the position of the vertices by dragging (moving) the large red circle.
- You can increase the vertices by dragging the smaller red circle.
- You can delete vertices by clicking on the large red circle and pressing the delete key on the

keyboard. (The click position may be quite severe and difficult to delete)

・If you click anywhere else, the red circle will disappear and the correction mode will end.

Press the Clear button to clear (deselect) the polygon.

3.1.3. Line Selection (Line Selection)

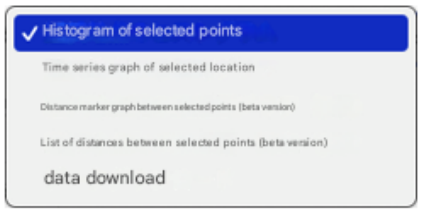
This is a method of drawing a line by clicking on two or more points on the map. Double-click on the last point to complete the line drawing. When the line drawing is complete, the length of the line is displayed in the lower right corner, such as "Distance=255m". On the map, a balloon with S appears at the starting point and E at the end.

Pressing the Modify button allows you to change the position of the vertices of the line, just like the polygon selection in the previous section.

Press the "Save" button to download the latitude and longitude of the line vertices as a CSV file.
If you press the "Import" button and select the downloaded CSV file, the lines will be drawn without clicking on the map.

Press the Clear button to clear (deselect) the polygon.

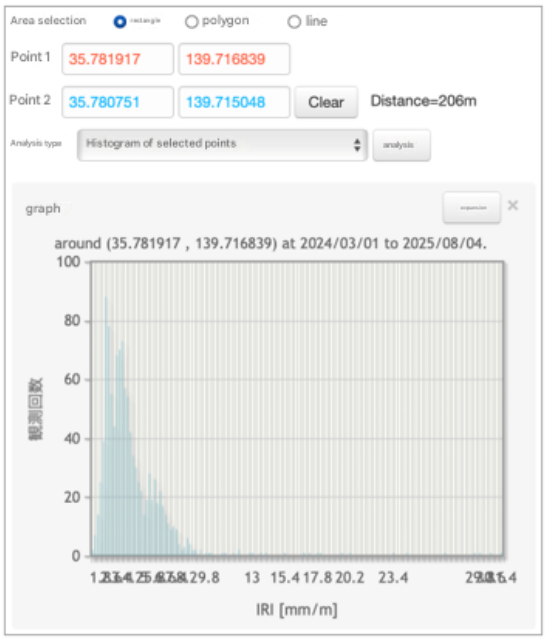
3.2. Graph Display



In addition to displaying histograms, time series graphs, and distance marker graphs, you can view a list by distance and download data. Perform the area selection described in the previous section first and display a graph of the data in the selected area along the selected line. Graph display of the data of the section of square mesh size 2 (section length of more than 20 m).

*Data download will be described in a separate chapter.

3.2.1. Histogram of the Selected Point



Select "Histogram of Selected Points" in the "Analysis Type" select box, press the "Analyze" button on the right, and wait for a while to display the graph. (It can take quite a while.)

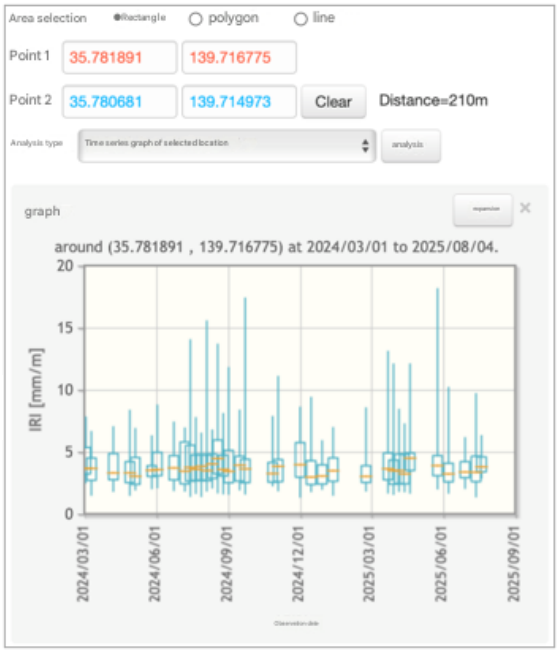
Format: Histogram

Horizontal axis: The value of the indicator

Vertical axis: Number of sections (frequency)

Press the "Enlarge" button in the upper right corner of the graph to display the graph in a larger way. Press the "X" symbol in the upper right corner of the graph to close the graph.

3.2.2. Time Series Graph of Selected Points

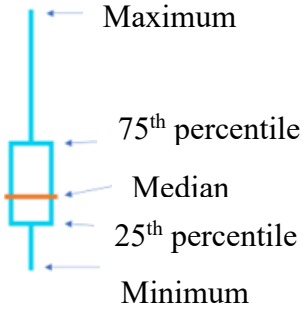


Select "Time Series Graph of Selected Points" in the "Analysis Type" selection box, press the "Analyze" button on the right, and wait for a while to display the graph. (It can take quite a while.)

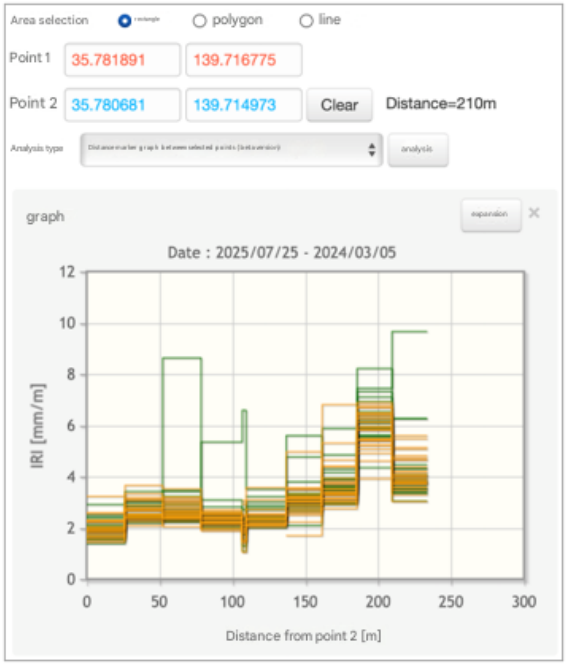
Format: Box Drawing

Horizontal axis: Measurement date

Vertical axis: The value of the indicator



3.2.3. Distance Marker Graph Between Selected Points



Area selection is only supported for "rectangle" (two-point selection). Find and graph data with the first clicked point (point 2) as the starting point and the next clicked point (point 1) as the end point.

In the "Analysis Type" select box, select "Distance Mark Graph Between Selected Points", press the "Analyze" button on the right, and wait for a while to display the graph. (It can take quite a while.)

Format: Line Chart

Horizontal axis: Distance from the starting point (point 2)

Vertical axis: The value of the indicator

The orange line shows the data from the first half of "from" to "to" in the "Search Criteria", and the green line shows the second half of the data. If you hover your mouse over the graph line, a green circle will appear at the corresponding point on the map.

3.2.4. List by Distance Between Selected Points

The "distance mark graph between selected points" in the previous section is displayed in a list.

Area selection is only supported for "rectangle" (two-point selection). Find the data with the first clicked point (point 2) as the starting point and the next clicked point (point 1) as the end point and display it in a list.

Select "List of distances between selected points" in the "Analysis Type" selection box, press the "Analyze" button on the right, and a separate tab or window will open in the browser, and wait for a while to display the list. (It can take quite a while.)

IRI distance marker table [download]

distance [m]	latitude	longitude	average [mm/m]	2025 07/25	2025 07/19	2025 07/18	2025 07/17	2025 07/16	2025 07/15	2025 07/05
0	35.780588	139.714902	1.9	2.9	1.6	2.4	2.4	2.0	1.4	2.1
26	35.780785	139.715062	2.6	3.0	2.2	3.4	2.7	2.3	2.4	2.7
53	35.780983	139.715224	2.9	3.5	2.2	8.6	2.4	3.2	2.3	2.9
80	35.781181	139.715404	2.5	5.3	2.2	2.6	2.0	2.8	2.3	2.1
106	35.781373	139.715576	2.5	---	---	2.6	---	---	---	2.7
135	35.781541	139.71582	3.1	3.1	2.9	3.0	3.3	3.2	3.8	3.3
160	35.781639	139.716065	3.7	3.6	4.3	3.5	3.0	3.5	3.6	3.9
184	35.781727	139.716309	6.2	6.3	8.2	6.4	5.9	7.4	5.5	5.9
208	35.781814	139.716553	4.2	4.0	3.5	3.5	3.9	9.7	3.7	3.3

legend

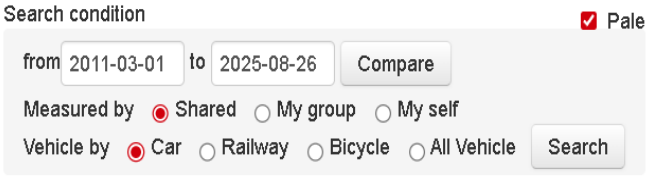
0 3.4 <=6.7

You can download the table as a CSV file by pressing “download" above the list. (It takes time.) CSV, so it won't be colored)

4. Application (Comparison of Old and New)

This is a feature of paid IDs. Not available with a free ID.

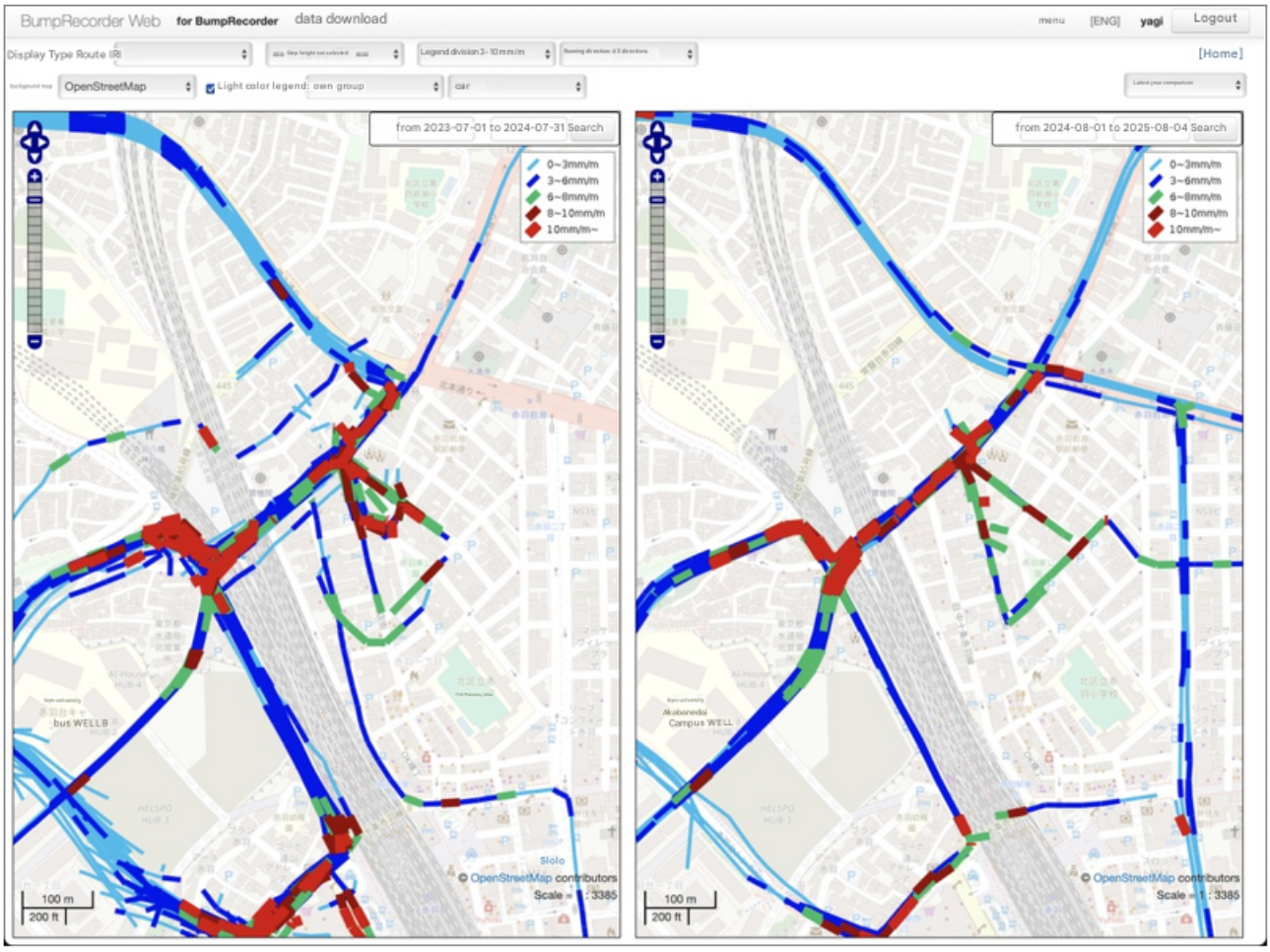
Press the "Compare Old and New" button to the right of "To" in the "Search Conditions" at the top of the panel to move to another screen.



Two maps of the same location are displayed.

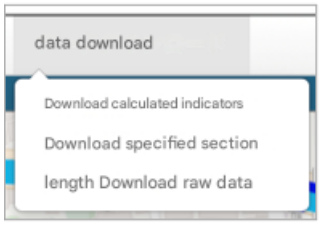
The display conditions of the two maps differ only on the date. You can select a date in the top right corner of the map. By default, data from more than one year old is displayed on the left, and data from less than one year old is displayed on the right. When you move the map on the one hand, the other moves in the same way.

Click "Home" in the upper right corner of the screen or "BumpRecorder Web" in the upper left corner of the screen to return to the standard screen.


BumpRecorder Web
for BumpRecorder
data download
menu
[ENG]
yagi
Logout
[Home]
OpenStreetMap
Light color legend: own group
car
from 2023-07-01 to 2024-07-31 Search
from 2024-08-01 to 2025-08-04 Search
0~3mm/m
3~6mm/m
6~8mm/m
8~10mm/m
10mm/m~
bus WELLB
Akabanedai
Campus WELL
Sloio
© OpenStreetMap contributors
Scale = 1 : 3385
100 m
200 ft

5. Application (Data Download)

5.1. Download per measurement file



Click the top menu "Data Download" to open a submenu with calculated indicator download, specified section length download, and raw data download.

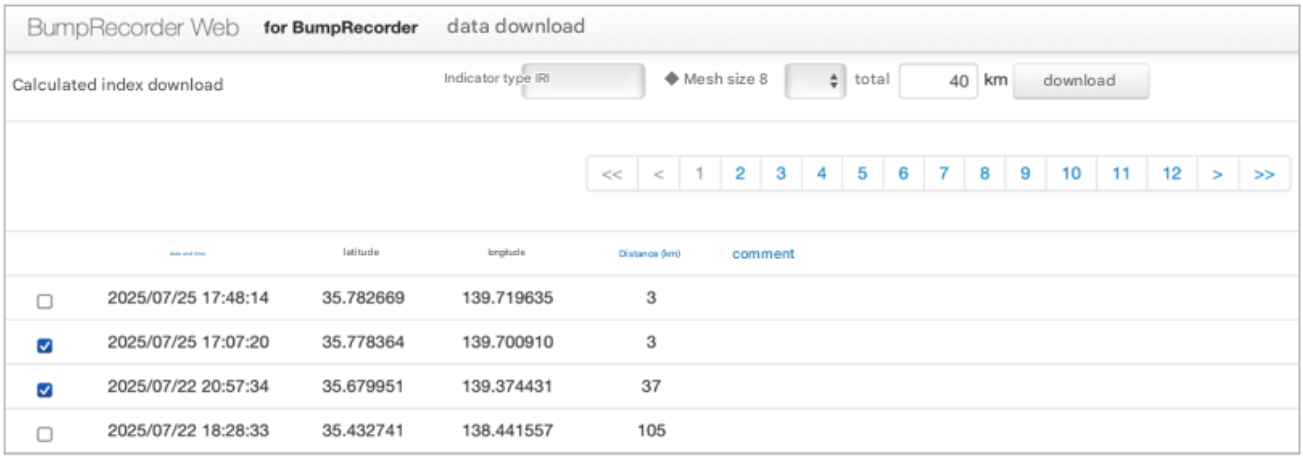
*Cannot be used without an ID.

5.1.1. Download Calculated Indicators (for pay-as-you-go: free IDs and pay-as-you-go IDs)

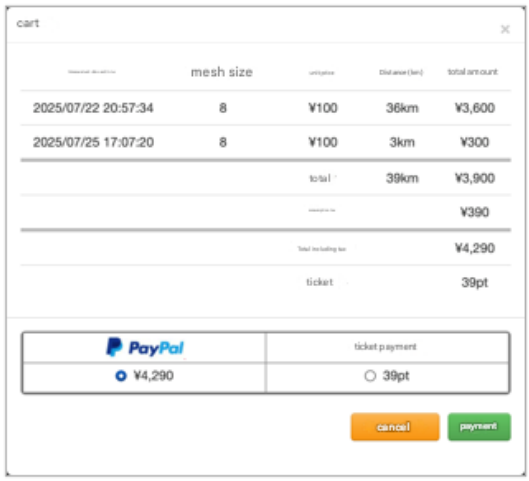
You will be charged each time. Flat-rate IDs have different screens. Please refer to the following section.

If you select "Download Calculated Indicators" from the top menu "Data Download" on the standard map screen, you will be redirected to the following screen.

1) Select the index type from IRI, flat σ, and crack rate.
2) Choose from 2, 4, 8, 16, and 32 mesh sizes.
3) Check the box on the far left of the data you want to download.
4) Press the "Download" button in the upper right corner of the screen.



5) A confirmation dialog will open, check the date and time of measurement of the data, mesh size, distance, and amount, select PayPal payment (credit card payment) or "Ticket payment" and press the "Pay" button.



6) The download will start automatically when the payment is completed.

*PayPal. It is not PayPay.

*Purchased data can be downloaded again without re-charging by pressing the "Download" button.

*If you want to "pay for tickets", please press "Buy Tickets" in the upper right corner of the screen in advance, and then press the "Buy Tickets" button on the transitioned screen to purchase tickets with PayPal payment (credit card payment). There will be no refunds for tickets.

5.1.2. Download Calculated Indicators (for flat-rate IDs)

It is included in the contract and there is no additional charge. Free ID and metered ID have different screens. Please refer to the previous section.

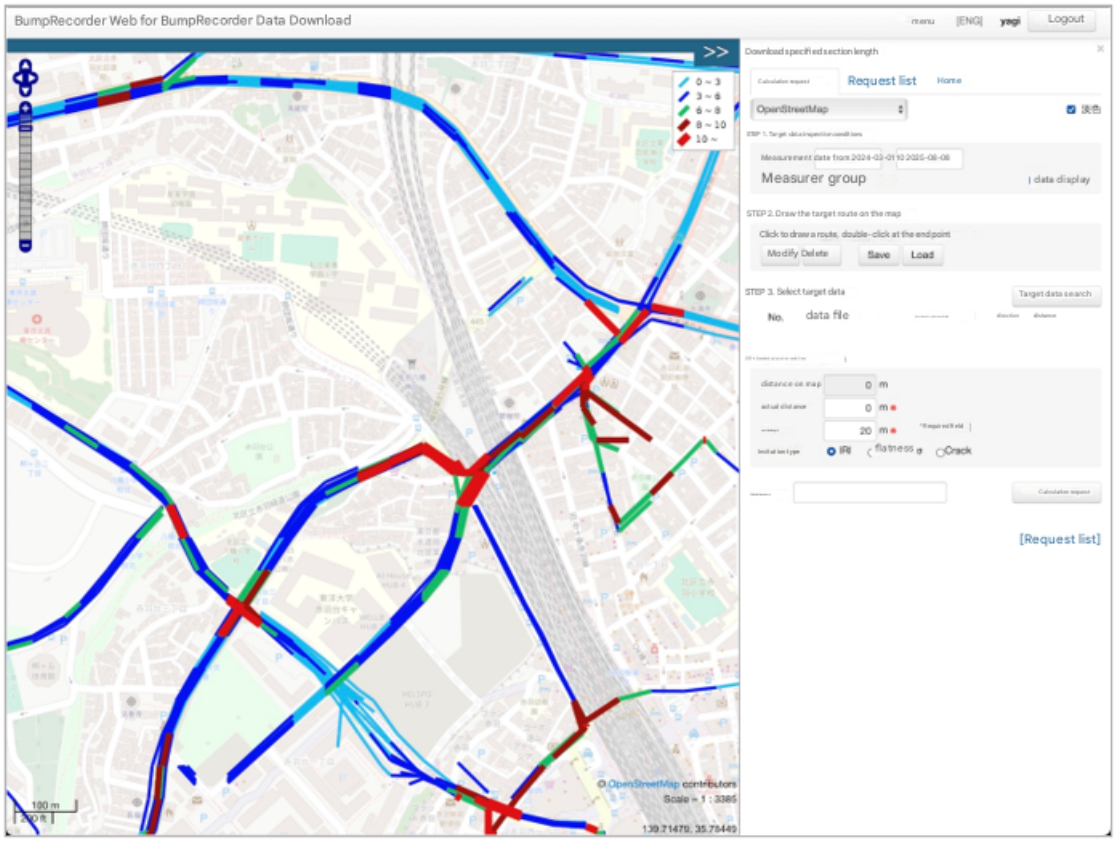
If you select "Download Calculated Indicators" from the top menu "Data Download" on the standard map screen, you will be redirected to the following screen.

Press the "Analysis Data" button on the far right of the data you want to download to start downloading.

5.1.3. Specified Section Length Download

This is a feature only for flat-rate IDs. Even a flat-rate ID cannot be used outside the contract period.

If you select "Download Specified Section Length" from the top menu "Data Download" on the standard map screen, you will be taken to the following screen. It is similar to the standard screen, but with a dedicated screen. The data shown on the map is IRI.

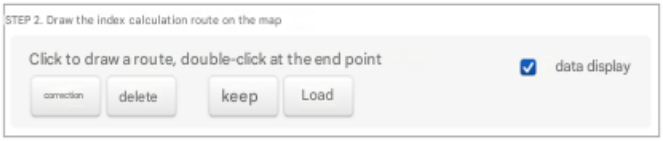


Set the STEP 1 to 4 in the panel to request the calculation and download the calculation result from another screen.

Step 1. Search Criteria for Target Data

Since multiple data cannot be requested at once, narrow down the measurement date and measurement person to make it easier to select data in STEP 3.

Step 2. Draw the Index Calculation Route on the Map



Draw the route to be calculated on the map.

The operation method is the same as "3.1.3 Line Selection" on the standard screen.

IRI is displayed on the map so that you can see where the measurement data is. If the data is in the way and it is difficult to see the background map, please turn off the "Data Display" checkbox.

Step 3. Select the Target Data

Press the "Search for Targeted Data" button. After waiting for a while, a list of data along the route drawn in STEP 2 will be displayed. Check one of the boxes on the far left. (Multiple checks are not allowed)

The meaning of the list is as follows.

Data files

The file name of the metering data.

- **Section entry date and time**

Since the same data file that is orbiting at the time of measurement corresponds to multiple times, the date and time of entering the drawn path is displayed.

- **Orientation**

> order: Data that ran in the same direction as the route drawn.

Reverse <: Data that ran in the opposite direction to the drawn path.

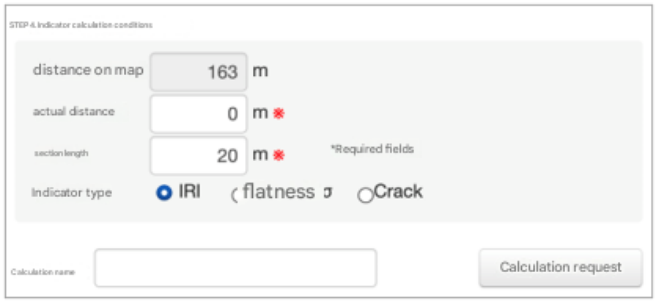
- **Distance**

Sufficient: The same length of data as the route drawn can be calculated.

xx%: For some reason, some of the routes cannot be calculated, and only xx% can be calculated.

Step 4. Indicator Calculation Conditions

The length of the path drawn in STEP 2 is displayed. Enter the "actual distance" and "section length".



*Actual distance: For example, if a kilopost is set on the target road and there is 1020m when drawing a route worth 1KP, it will be 51 sections calculated with a section length of 20m. However, if you want to divide the 50 sections equally according to the KP, enter 1000m in the "Actual distance" field.

*Section length: 10m or more, can be specified in 1m increments.

*Handling of surplus: If the actual distance is 1010m and the section length is 20m, it will be separated by 20m from the starting point of the drawn route, and the last section of the end point will be calculated as 10m.

The "Calculation Name" field is optional. This is a remarks column to make it easier to find the calculated results on the screen where you download them.

Press "Calculation Request" to start calculation.

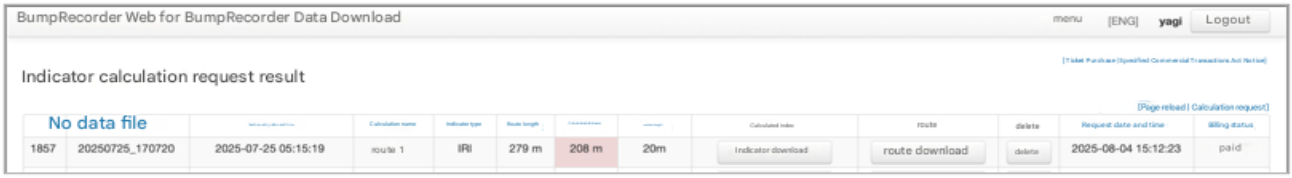
Request List

There is a "Request List" link at the top and bottom of the panel on the request screen. Click on it to go to the screen below.

"Download Indicator" button: You can download the calculation results.

"Download Route" button: You can download the route you drew in STEP 2.

"Delete" button allows you to delete unwanted requests.



*Old request data will be automatically deleted.

5.1.4. Raw Data Download

If you select "Raw Data Download" from the top menu "Data Download" on the standard map screen, you will be taken to the following screen.

[Original File] button

Both free and paid IDs are available.

You can download raw data. "Raw data" refers to acceleration data and GPS data recorded on smartphones and AtomicBump, a fully automated measurement terminal.

[Vehicle Axle Conversion File] button

Only subscription IDs are available (only during the contract period).

Acceleration data is 3-axis acceleration but depending on the installation posture of the smartphone or dedicated terminal, which axis is up and down, left and right, and forward and backward. In addition, acceleration, GPS, etc. are acquired asynchronously, so each is recorded in a separate file.

You can download this as X-axis: left and right, Y-axis: forward and backward, Z-axis: up and down, and then download a single file (time, latitude and longitude, acceleration, and gyro values on one line).

[Convert to App Version Format] button

Both free and paid IDs are available.

The acceleration file of the smartphone app BumpRecorder App is a text file, but the acceleration file of the dedicated device AtomicBump is a binary file. You can download this binary file as a text file in the same format as the BumpRecorder App.

5.2. Select an Area on the Map and Download

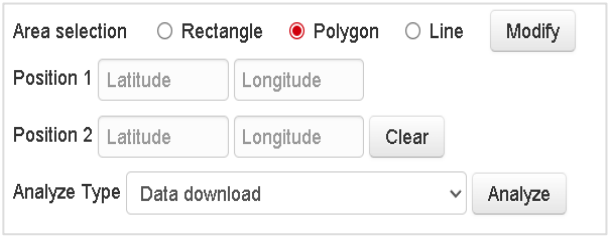
This is a feature of a subscription ID. It is not available for free IDs or metered IDs.

5.2.1. Area Selection

The operation of selecting an area or route on the map on the standard screen is the same as "3.1. Area Selection" in "3. Basics (Graph Display)". Please refer to that.

5.2.2. Download

Select "Data Download" in the "Analysis Type" select box.

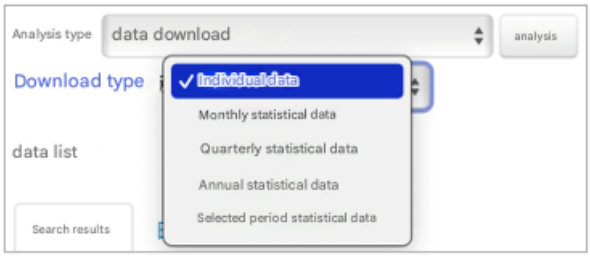


If the area selection is a rectangle or polygon

Press the "Analyze" button and wait for a while to download the calculated indicators in the area in text file format. You can also specify the driving direction in the "Display Type" panel. Regardless of the selection in the "View type", all metrics are downloaded.

If the area selection is a line

When you select Line, the Download Type selection box appears below the Analysis Type selection box.



・Individual data

Download data for each measurement without statistical statistics.

・Monthly statistical data

For each distance from the starting point of the drawn line, statistical data such as average and median values are downloaded in text format every month. The graph is also downloaded in SVG format at the same time.

・Quarterly statistical data

Download statistics for January-March, April-June, July-September, and October-December.

・Annual statistical data

Download the statistics for January-December. (Not in the April-March fiscal year)

・Selection period statistical data

Download statistics for the entire time period selected in the "Search Criteria" panel.

Press the "Analyze" button and wait for a while to download the calculated indicators in text file format or other formats. It takes longer than rectangles and polygons.

*For the English notation and meaning of the indicators in the download file, please refer to "6.1.1. Section Definition Indicators" in "6. Appendix".

*The following notation is used in the download file of statistical data.

p010 : 10th percentile value
p025 : 25th percentile value
p050 : 50th percentile (median)
p075 : 75th percentile value
p090 : 90th percentile value
avg : mean
sd : Specimen standard deviation

*SVG files are a type of image file that can be viewed in browsers as well as retouching software.

6. Appendix

6.1. Metrics

There are two main types of evaluation indicators calculated by BumpRecorder: segment definition indicators and point-defined indicators (both are not general terms but are notations in this manual).

6.1.1. Interval Definition Indicators

Like IRI, it is a metric that defines a single evaluation value for the section from here to there (e.g. about 20 meters) and is displayed on the BumpRecorder Web map as a color-coded line.

Indicator name	Explanation
IRI [mm/m] conformance	International Roughness Index, the average of the absolute suspension expansion and contraction when a vehicle with a specified weight and suspension stiffness is traveling at 80 km/h. Since it cannot actually run at this vehicle speed, it is calculated by computer simulation from the longitudinal profile.
Flat σ (JRI) [mm] Almost compliant	Standard deviation of the 3m profilometer reading. BR is calculated by computer simulation from the longitudinal profile. BumpRecorder describes it as JRI: Japanese Roughness Index like IRI.
Crack rate [%] Almost unique	BR does not take images and estimates from acceleration data. Therefore, it can only reflect the crack condition on the road surface (survey line) that the tire stepped on. The checkbox says "crack rate", but it is the original index of the bamp precoder company, "line crack rate".
Linearity σ (linearity) [mm] original	The flat σ is calculated from the upper and lower accelerations, but the same logic is applied to the left and right accelerations. The operating state (steering situation) is included, but if there is a phase difference in the longitudinal profile of the left and right survey lines (if there is unevenness on only one side), left and right acceleration will occur and it will be a large value.
velocity [m/s][km/h]	Average speed in the section.
MCI [Dimensionless] Somewhat unique	Maintenance Control Index, 10 is the best, and 0 is the worst. The calculation formula uses a formula calculated from two indicators, flatness σ and crack rate, and a formula calculated from three indicators: rut digging amount = 0, and the smaller value is adopted. However, BR uses

	the measurement line crack rate instead of the normal crack rate, so it is practically a unique indicator. https://www.pwrc.or.jp/yougo_g/pdf_g/y1104-P053-054.pdf
PCR [Dimensionless] Somewhat unique	Pavement Condition Rating, an indicator of the United States where 100 is the best and 0 is the worst. However, BR uses the measurement line crack rate instead of the normal crack rate, so it is practically a unique indicator. https://www.carbonyte.com/Documents/PCR%20Distress-ID-Manual.pdf
LTx [Dimensionless] conformance	Indicators for railways. An index developed by the Railway Research Institute that assumes the evaluation of ride comfort on the Shinkansen. An indicator like an adjustment of the parameters of ISO2631-4. The higher the price, the worse the ride comfort. LTx is an evaluation of vibration in the left and right directions. There is speed dependence and vehicle dependence.
LTz [Dimensionless] conformance	Indicators for railways. The higher the price, the worse the ride comfort. LTz is an evaluation of vertical and vertical vibrations.
Ax [db] conformance	Indicators for railways. The left and right acceleration is applied with a 10Hz low-pass filter, and the maximum value within the (absolute) range of the adjacent maximum to extremely small amplitude difference. There is speed dependence and vehicle dependence.
That [db] conformance	Indicators for railways. The upper and lower acceleration is applied by a low-pass filter of 10 Hz, and the difference between the most recent maximum and minimum amplitude (absolute) is the maximum value in the interval.
Local deformation (dist_z) [Dimensionless] original	A composite index obtained from the ratio of LTz to Az. LTz is the interval average, and Az is the interval maximum, so if there is a local variation, it will be a large value. Even in the case of interlocking, it is not a big value if there is no local deformation.
Horizontal G (dist_x) [Dimensionless] original	A composite index obtained from the ratio of LTx to Ax. Left-right version of the local deformation indicator. Includes driving behavior and steering status.

*The description under the index name has the following meanings.

Conformance Calculated according to the definition.

- Almost compliant: It is calculated according to the definition formula but uses 25 cm data instead of 1.5 m data.
- Some what unique : It is calculated according to the definition, but some original indicators are used.

Almost unique similar to regular indicators, but with slightly different definitions.

Original index created by BumpRecorder Co. Ltd.

*The () in parentheses below the indicator name is written in English in download files, etc.

*[] Under the index name, the [] in parentheses is the unit. [Dimensionless] has no units.

*"In BR" in the description column describes the calculation method with BumpRecorder.

6.1.2. Location Definition Metrics

This is an indicator defined in "This Location" and is displayed on the BumpRecorder Web map as a size triangle.

Indicator name	Explanation
Step height (2m) [mm][m] Compliance and Expansion	The methods described in the pavement survey and test method handbook were carried out by computer simulation from the longitudinal profile. A 2m water thread is applied to the road surface, and the distance with the largest deviation from the road surface is defined as "step height". "Step height" is defined not only for stair-like steps, but also for undulating parts such as the rubbing part of a manhole. In BR, the definition is expanded to define a negative step height when the water thread comes to the bottom of the road surface. The position of the step and the short distance to the position of both ends of the water thread are defined as the "step length". It is close to the BBI: Boeing Bump Index used at airports overseas. (However, BBI does not stipulate the length of the water thread.)
(10m) [mm][m] Compliance and Expansion	The step height was calculated using a 10m water thread. (In the pavement survey and test method handbook, it is a water thread of 2m, 10m, and 15m)
(15m) [mm][m]	The step height was calculated using a 15m water thread. (In the pavement survey and test method handbook, it is a water thread of

Compliance and Expansion	2m, 10m, and 15m)
On the spring [mm][m] original	The vertical and vertical movements are calculated by integrating the upper and lower accelerations measured on the vehicle's dashboard, and the adjacent maximum to extremely small difference is defined as "spring upper step height". The index that became the starting point of the development of BumpRecorder. It is a value related to ride comfort, and if it is large, the ride is not comfortable. There is speed dependence and vehicle dependence.

*The description under the index name has the following meanings.

Compliance and Expansion in addition to the values calculated according to the definition formula, add your own attribute information.

Original index created by BumpRecorder Co. Ltd.

*[] Under the index name, the [] in parentheses is the unit. [Dimensionless] has no units.

*The point definition index also depends on the road surface conditions before and after, so it is accurately defined as a section, but BumpRecorder Web expresses it as a point (the size of a triangle) rather than a line color coding, so it is expressed as a point definition.

6.2. Index Calculation Interval: Square Mesh Interval

Since interval-defined indicators such as IRI are defined as representative values of intervals, the value of the indicator varies depending on the interval length at the same location, and even at the same interval length, depending on the position of the starting and ending points. Therefore, the method of defining the calculated interval is important, and if the length of the section or the position of the starting and ending points is different between the previous measurement and this measurement, the value will change no matter how accurately it is measured, making it difficult to compare before and after.

The conventional method is to separate with a kilopost (kilopost). In order to assign GPS positioning data to it, you need the corresponding data for latitude and longitude per KP (KP master). It is not uncommon for roads managed by local governments to not have this data.

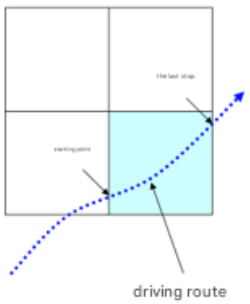
BumpRecorder uses "square mesh" and "square mesh section" as a unique method of bump recorder so that the calculated interval can be defined at the same start and end point without providing a KP master.

6.2.1. Square Mesh, Square Mesh Section, Mesh Size

A square mesh "square mesh" is defined on the earth in advance, and the section where the driving path crosses the mesh is one section. In other words, the starting and ending points are as follows.

Starting point: Position at the time of mesh entry

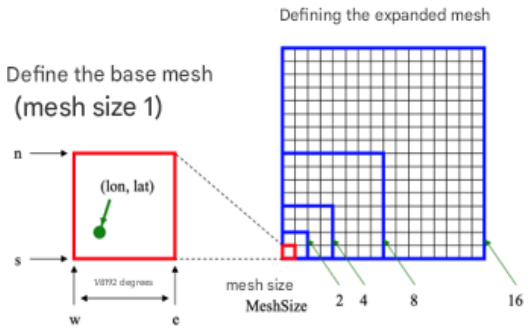
End point: Position at mesh exit



The length of 1 degree of longitude equal to 1/8192 (= 2 to the power of 13) is the east-west length, and the square with the same length from north to south is the standard mesh (mesh size 1).

*It is not exactly square, but slightly trapezoidal, but it can be considered a square in practical use.

*The length of the side changes depending on the latitude.



When latitude lat and longitude lon are given, the mesh numbers LatCode and LonCode are obtained using the following formula.

$$LonCode = int(\frac{lon}{8192})$$

$$LatCode = int(\alpha \times \int \frac{1}{cos(lat)}) = int(\frac{\alpha}{2} \times log(\frac{1+sin(lat)}{1-sin(lat)})$$

α=469367.1234291810

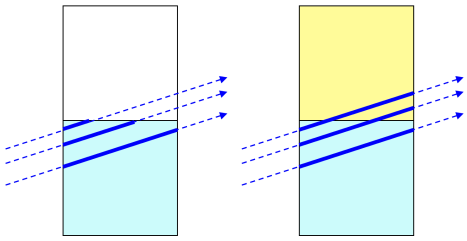
Let's say that a mesh with a side length of 2, 4 times, 8 times, 16 times (a power of 2) is a mesh size 2, 4, 8, 16... Rather than doubling or quadrupling from any reference mesh, we try to start at 0 degrees for all mesh sizes and latitude and longitude as shown below.

$$LonCode[MeshSize] = int(\frac{LonCode}{MeshSize})$$

$$LatCode[MeshSize] = int(\frac{LatCode}{MeshSize})$$

At a latitude of 36 degrees near Tokyo, the east-west length is about 11 m for mesh size 1 and about 22 m for mesh size 2. The standard size is set to 1/8192th of longitude so that it is easy to imagine the approximate length of one side.

6.2.2. Extended Square Mesh Segment



If the driving position shifts to the left or right due to GPS positioning error, the mesh passage position will change. If you pass through the corners of the mesh (for example, from the west side of the mesh to the north side), the section length will change significantly. This does not make the same section length even in the same place. Therefore, as shown in the figure on the right, the "extended square mesh section" is integrated with the adjacent mesh, so that the deviation of the driving position does not have a significant impact on the section length.

Below is the square mesh code, and the sample code of the program to find the extended square mesh section. Please feel free to use it.
https://www.bumprecorder.com/document/samplecode_squaremesh.zip

6.2.3. Mesh Size to Use

BumpRecorder calculates indicators for intervals with mesh size 2 or higher, and does not calculate indicators for intervals with mesh size 1.

Reason 1: If you consider the GPS positioning error to be about 5m, if you deviate 5m to the other side and 5m to this side, it will be almost the same as the section length by 10m,

and it will not be possible to compare in the "same section".

Reason 2: IRI is easy to respond to swells of about 15 meters, so the evaluation below that is because the suspension movement of the golden car in the QC (quadruple car) simulation (when it stretches out, when it shrinks, and when it comes to the neutral position) easily affects the IRI value.

*It is also possible to calculate with mesh size 1 with the option setting of the flat-rate system.

When viewing the map, zooming in displays data with a small mesh-size, and zooming out displays data with a larger mesh-size. Since IRI is an average value, the effect of local landslides is reduced at large mesh sizes (long section lengths), so large values such as red tend to be displayed less.

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