Automatic Data Collection System for Innovative Bridge Health Monitoring based on Public Bus Vibration

2013.10 CSHM-5

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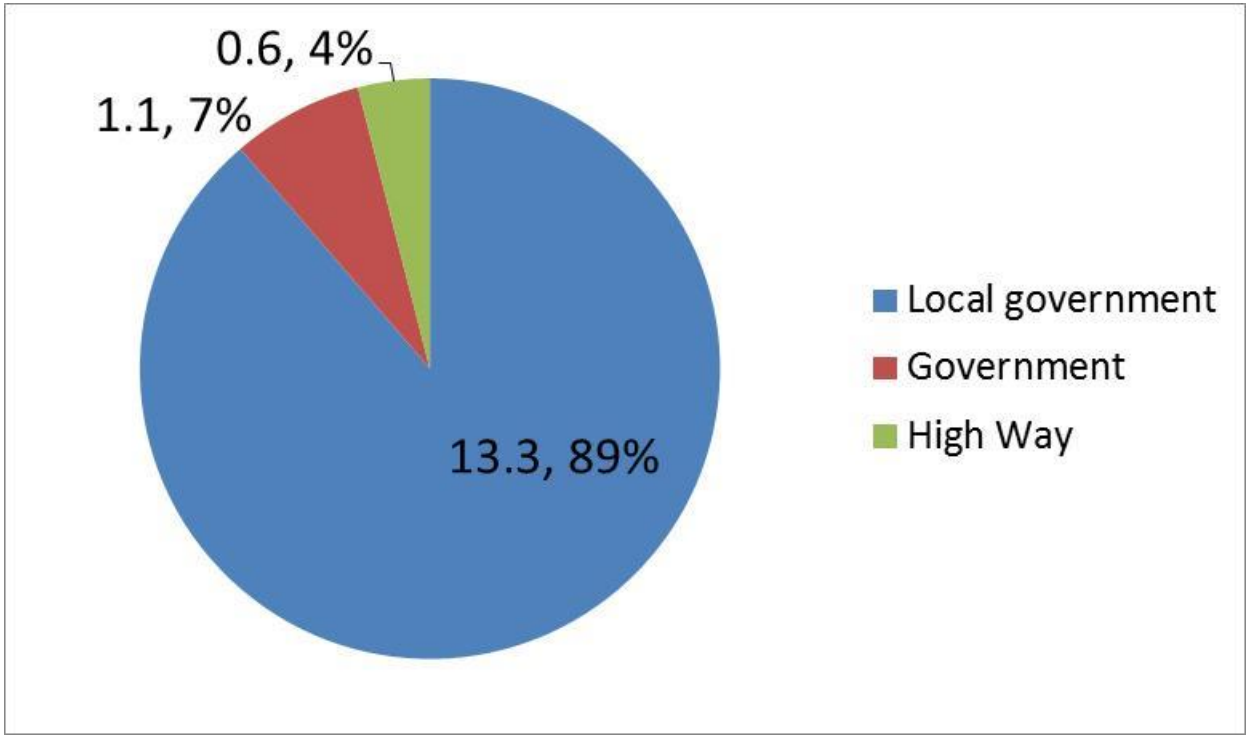
Motivation

15m over bridges management situation



Almost bridges are managed by local government.

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The accident of a bridge falling down in Japan

1989 at Nagano Pref.

1990 at Gifu Pref.

出典：第1回 道路橋の予防保全に向けた有識者会議 参考資料

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Opinions offered by the Ministry of Land

2008/5/16

Not inspection

Overlook

Postponing

The three most risky factors for the bridge management.

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What is truly required methods, devices and solutions ?

Rational.
Easy.
Low cos.

Such as a thermometer for bridges.

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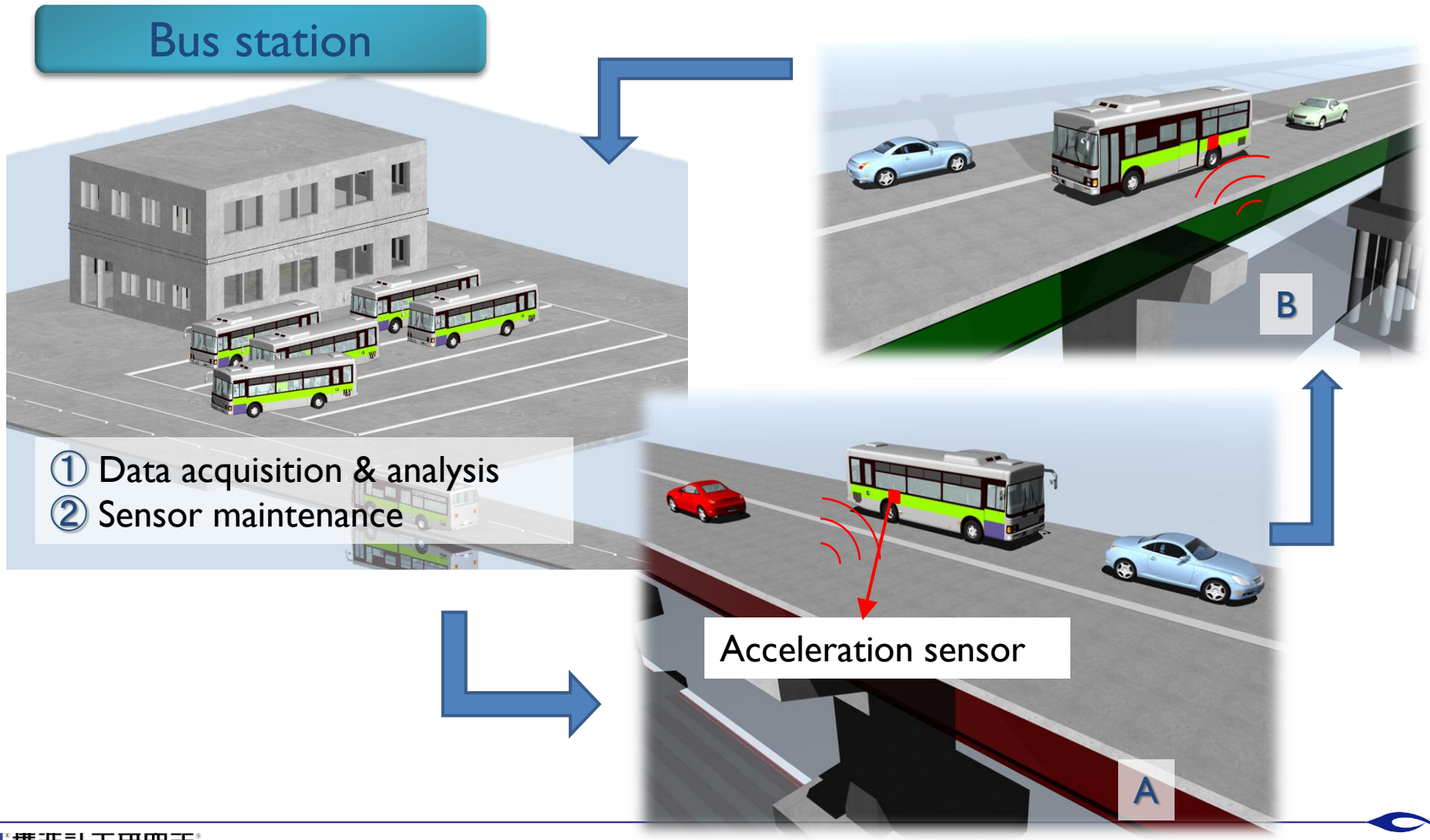
One of solutions by practical health monitoring system using city bus



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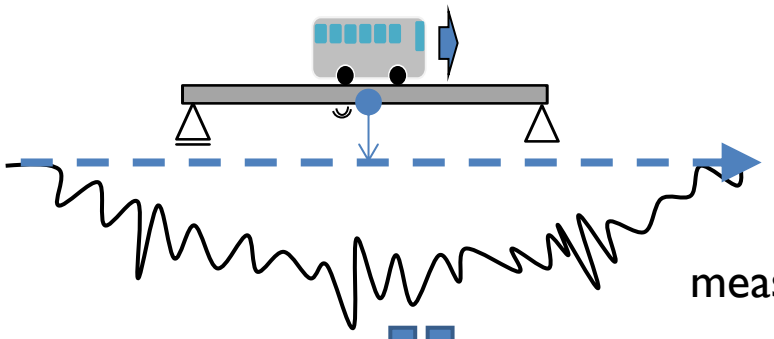
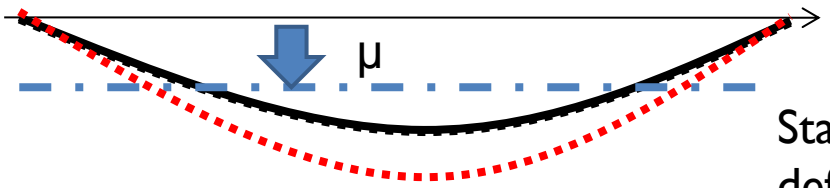
Rationale of calculating Characteristic Deflection



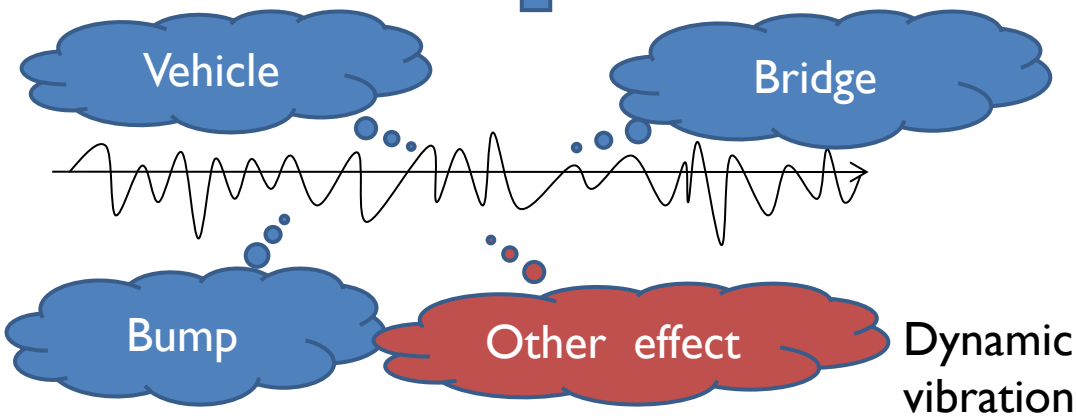
The average of measurements will converge to "μ".
"μ" is called "characteristic deflection"
"μ" is influenced by deterioration.

=



The average of static deflection responses will converge to "μ" .
In the case of deteriorated bridges, it is more small.

+



The average of dynamic vibrations responses will converge to "0" under the central limit theorem.
In the case of deteriorated bridges, it is same to "0"

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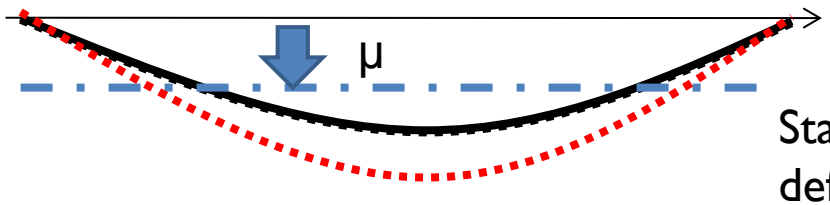
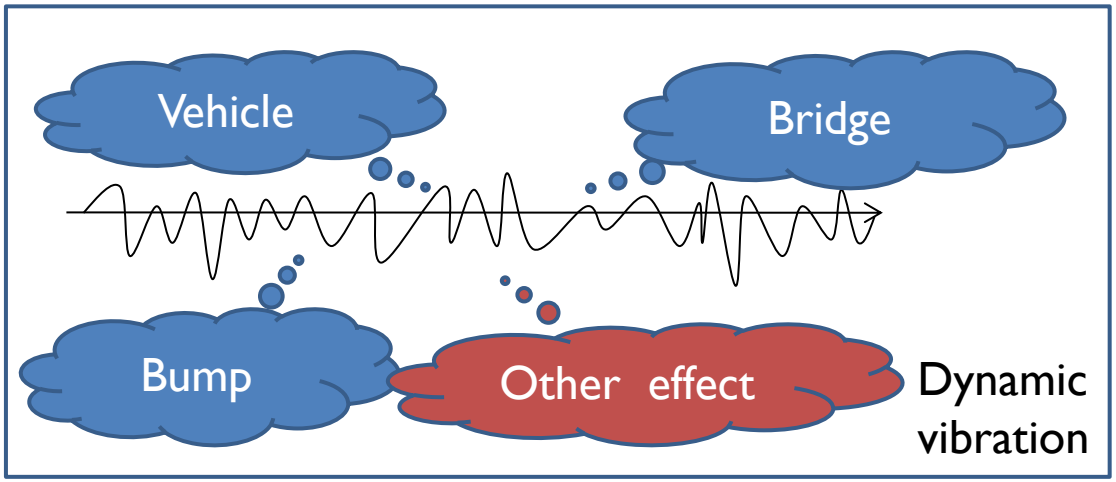
A necessary condition of applicable CD



Static deflection

It is necessary that static deflection is greater than dynamic influence



Dynamic vibration

In only this case
CD has the significant information of damage/deterioration-related.
Therefore a load have to be heavy such as a bus.

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Why city bus? Other merits.

Sensing problems	Merits by using city bus
Sensor maintenance	It is easy on a bus than many sensors on each bridges.
Number of sensors	One of city bus is cover a certain area bridges.
Power supply	Using city bus battery.

＜Others＞

It is possible to monitoring everyday

City bus is Heavy, so it is possible to become an reasonable exciting force.

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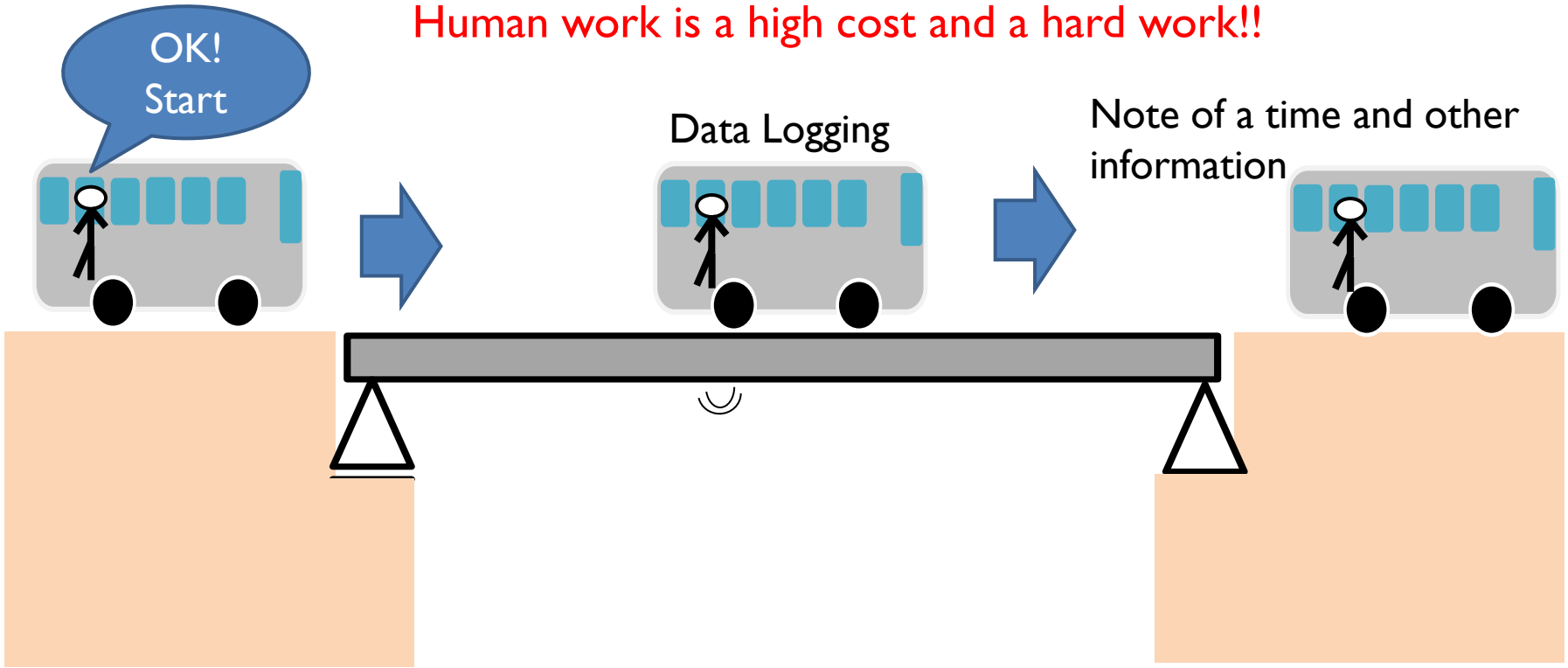
Why Automatic Data Collection System ?

Now this system is composed by only an acceleration sensor and manual operation data collection system. When measuring the acceleration of the bus vibration someone must be on the bus and make a note of a time and other information on passing the target bridge in all day.

Human work is a high cost and a hard work!!



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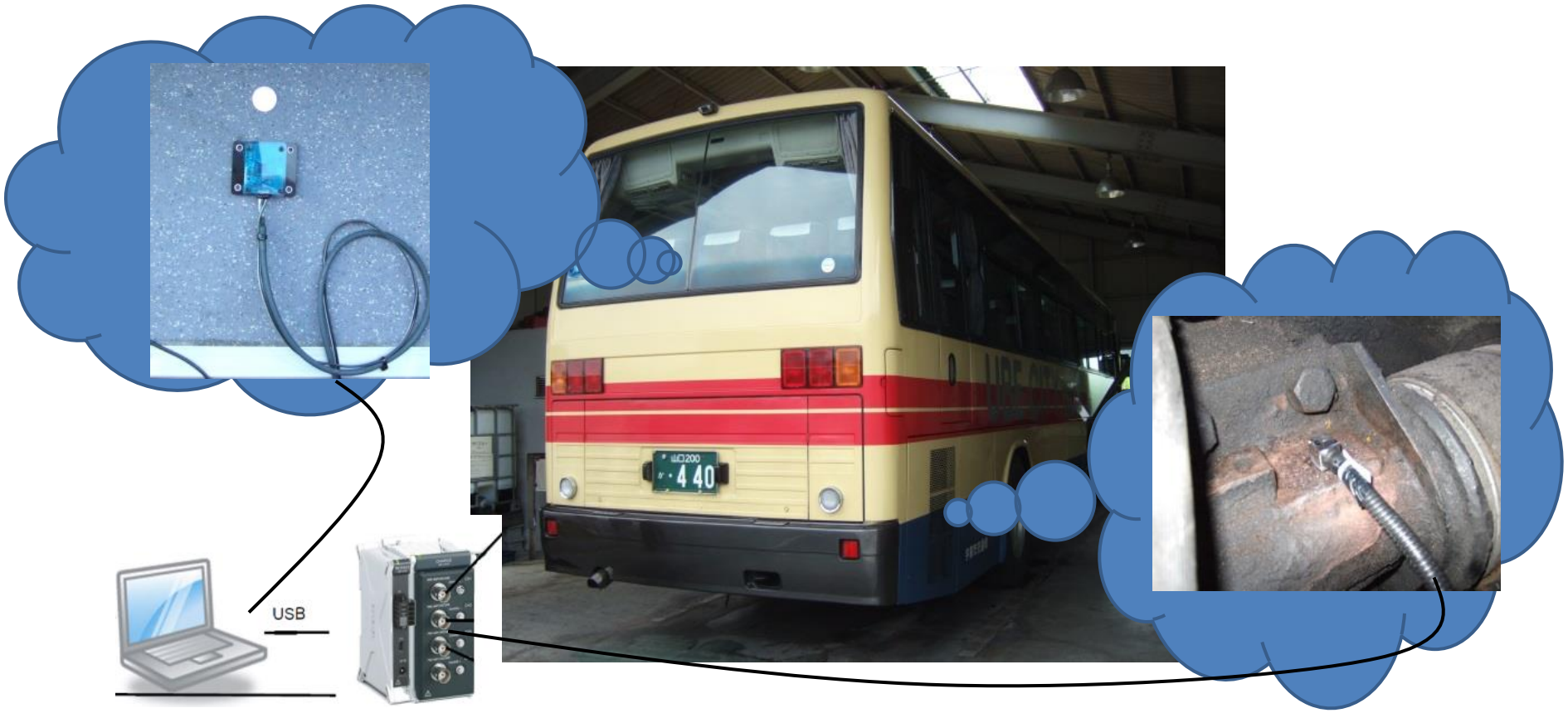
Automatic Data Collection　System by using GPS



Change human manual process for Automatic by GPS

This automatic data collection system will contribute to go low cost bridge management system.

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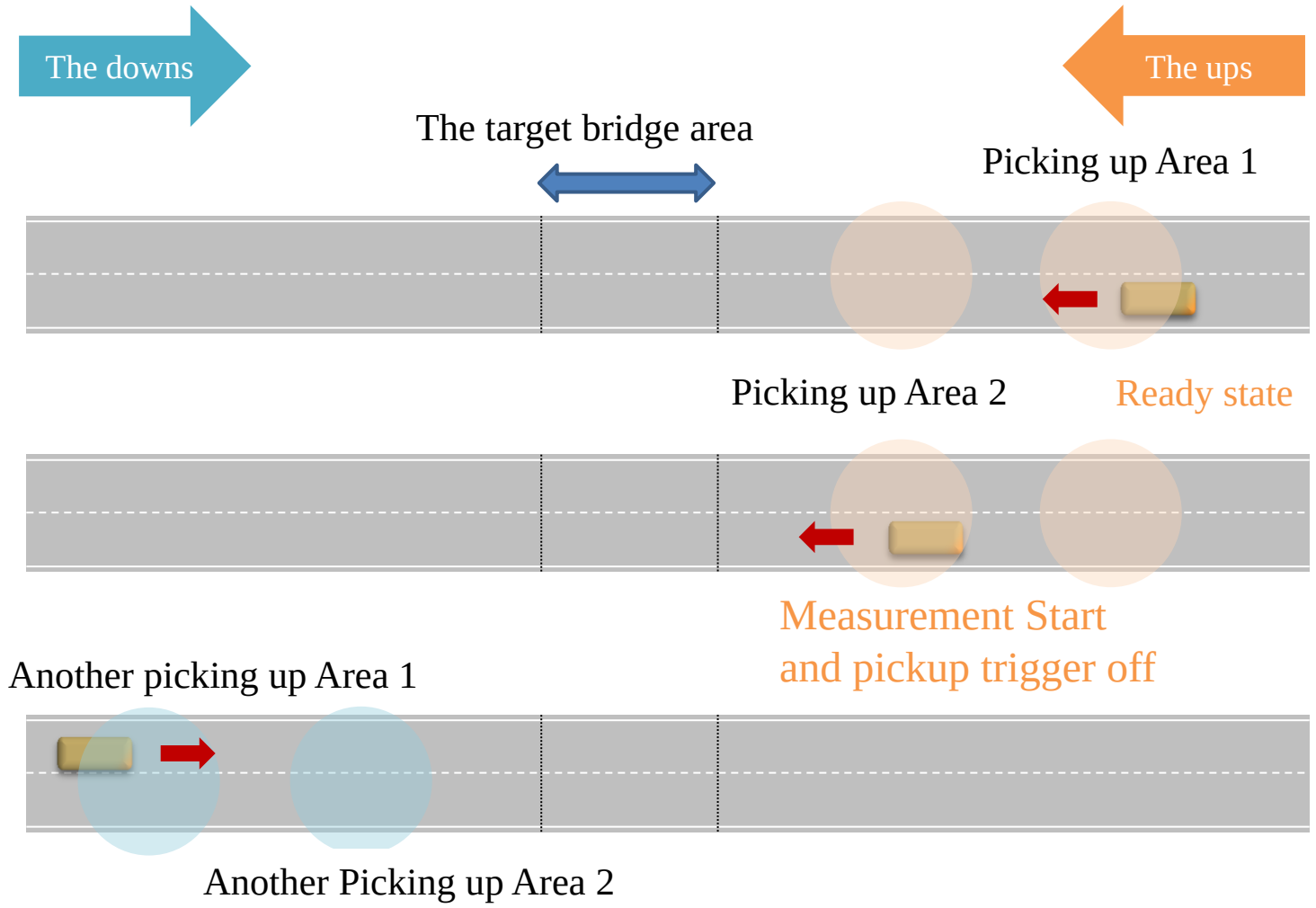

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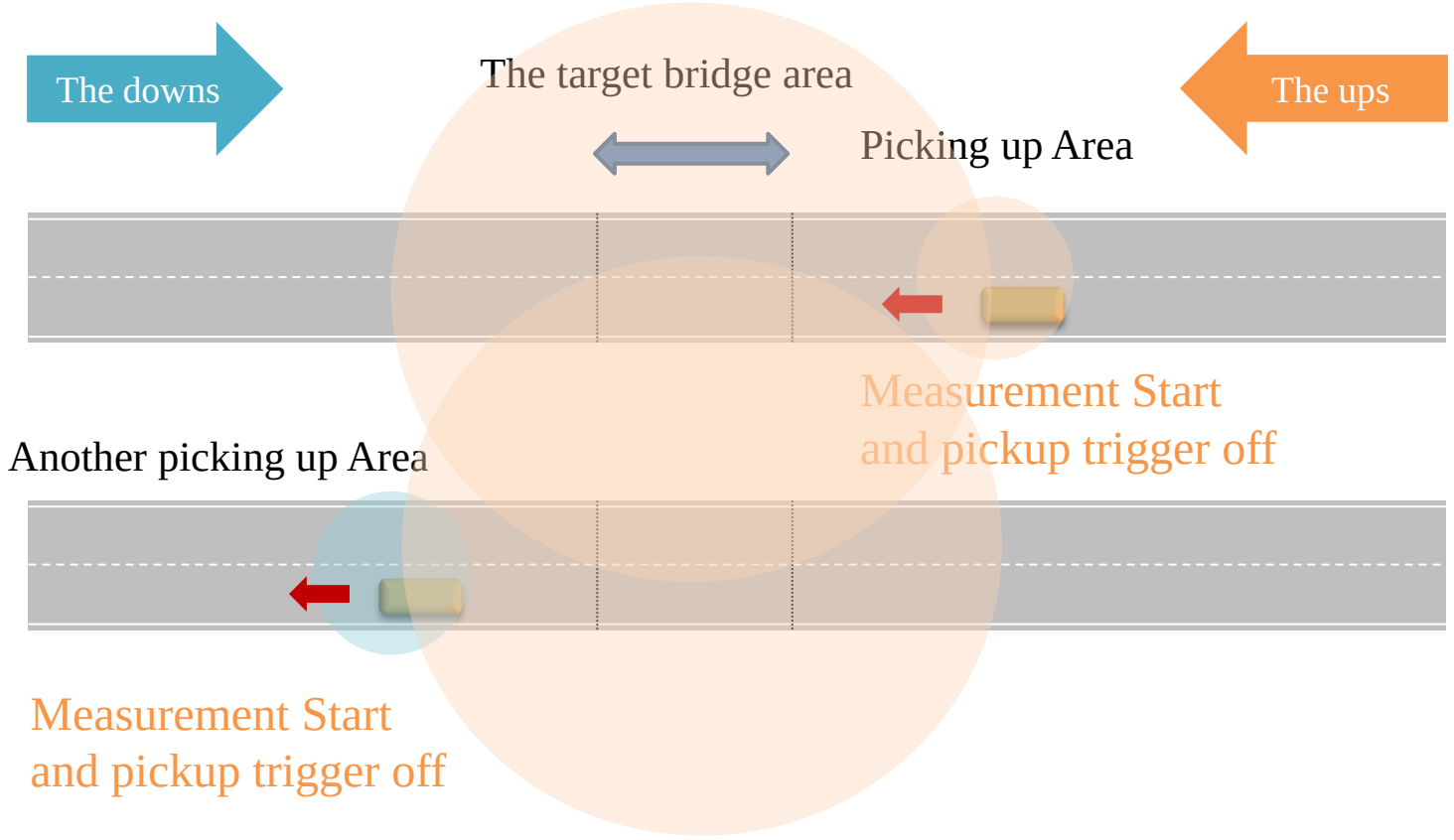

If it is one picking up area each side, in the after one side measurement another picking up area is working unintentionally and an unnecessary data will be saved.

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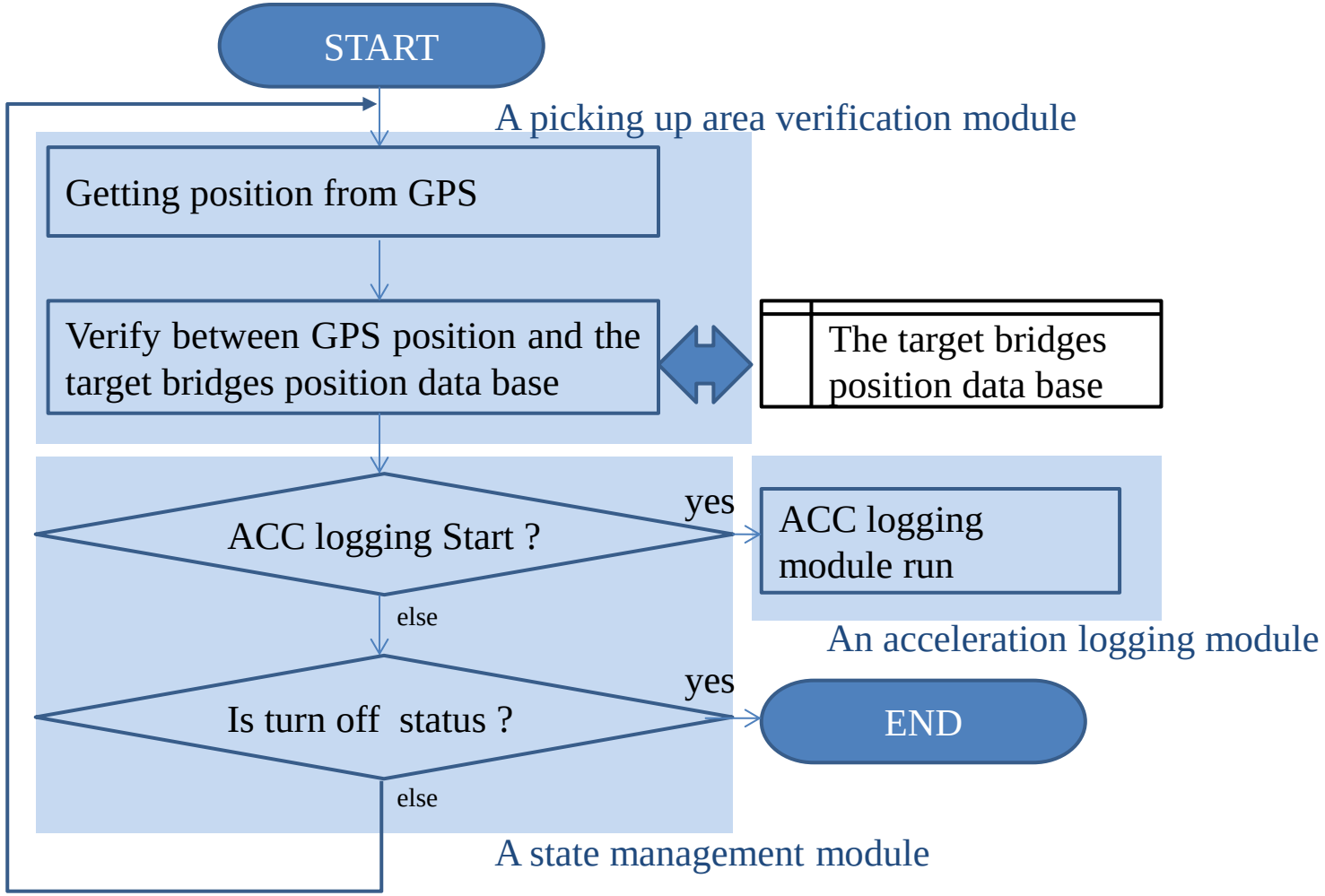

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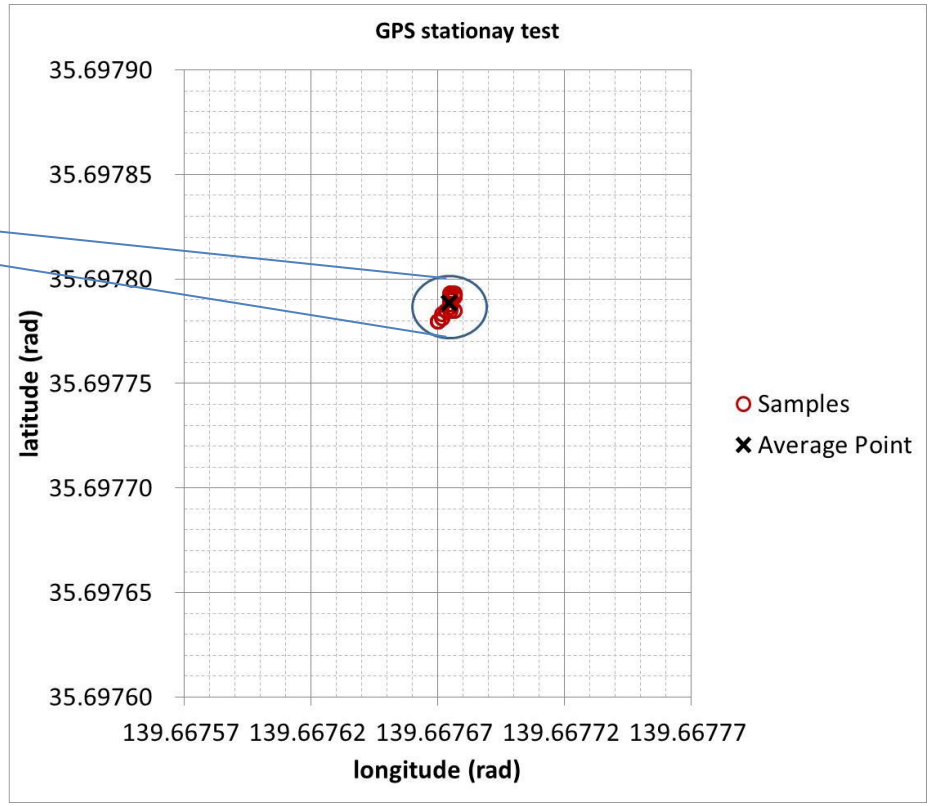

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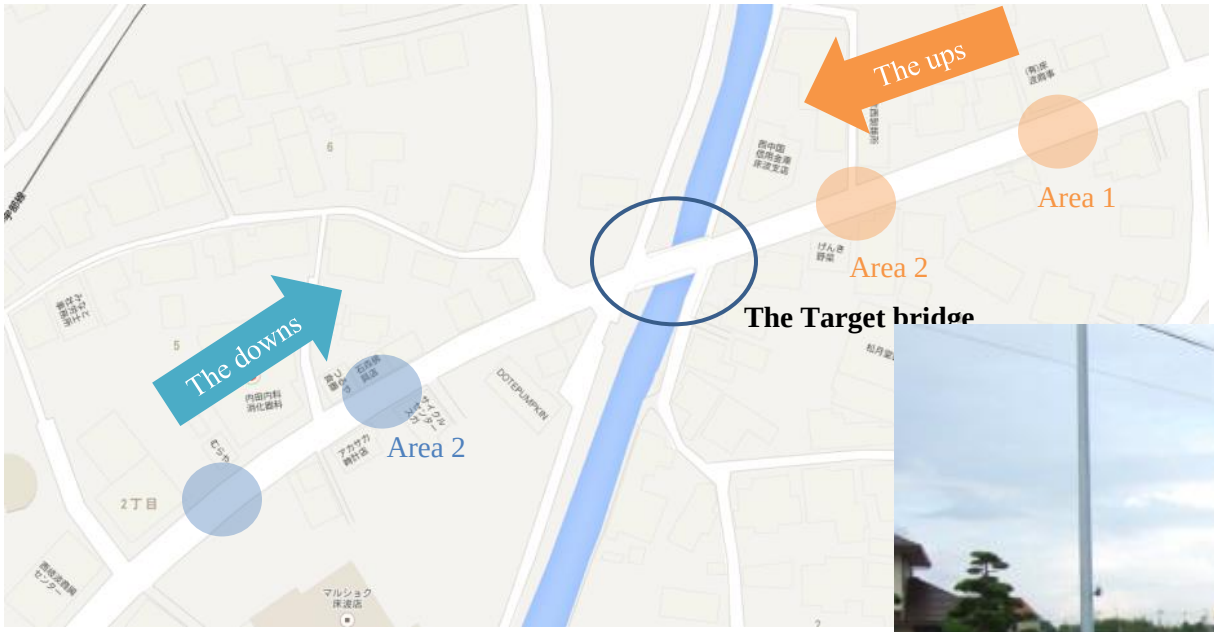

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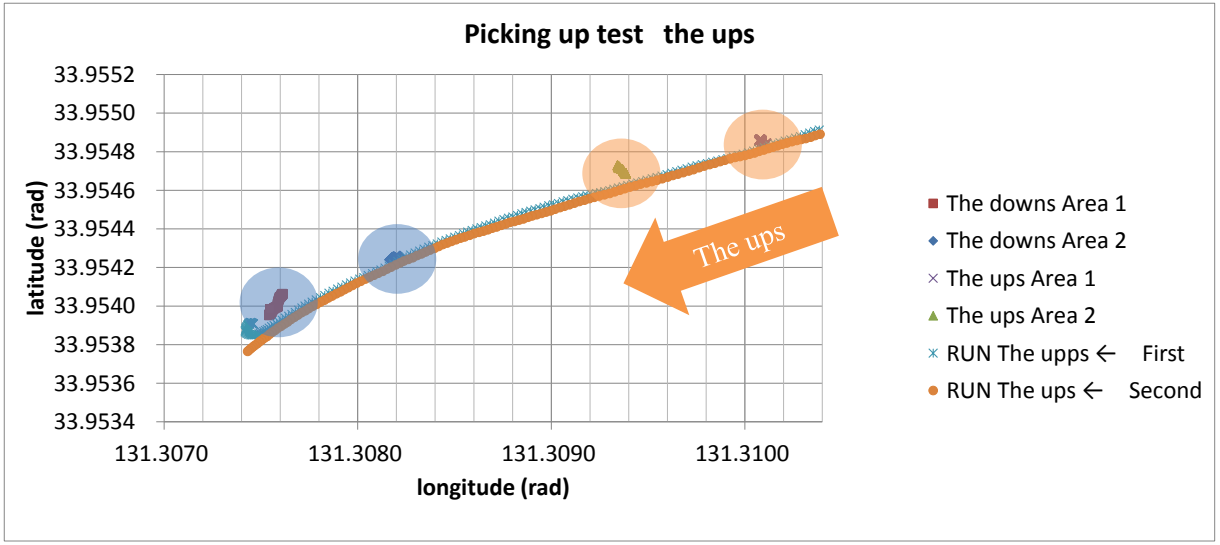
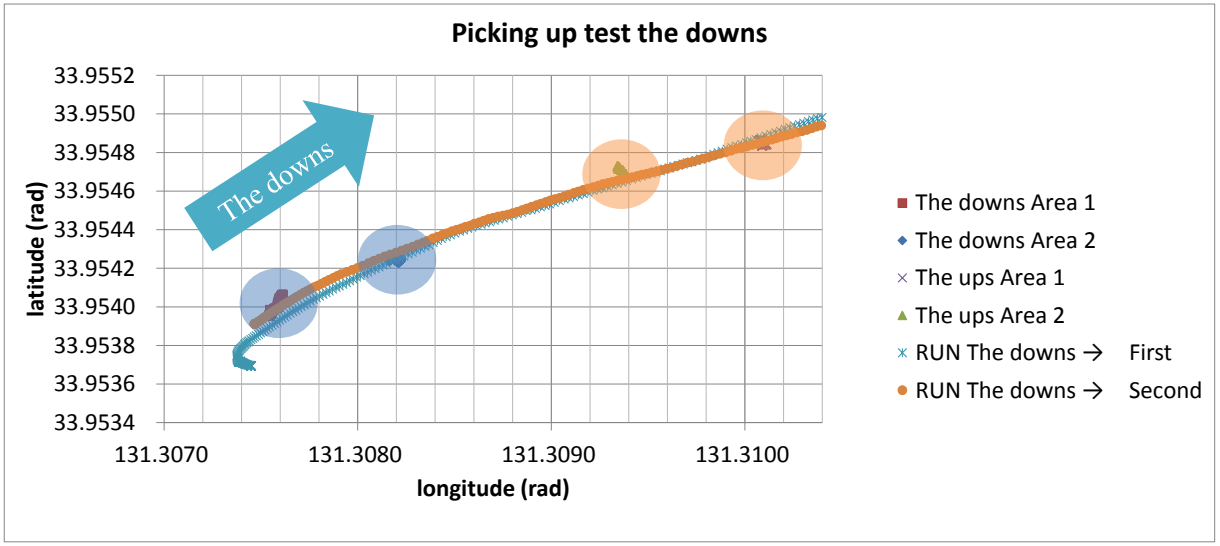


In the Ups case
The ups Area 1 was caught.
The ups Area 2 was caught.
The down Area 2 was ignored.
The down Area 1 was caught
but time out.



In the Downs case
The downs Area 1 was caught.
The downs Area 2 was caught.
The ups Area 2 was ignored.
The ups Area 1 was caught
but time out.

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Conclusions

(1) Under certain conditions using GPS is feasible for the automatic data collection system.

(2) A running to the ups or the downs is able to detect by picking up Area1 and Area2 in this system.

I'd like to propose other reasonable measurement systems which is combined with GPS, acceleration sensors, and so on.

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That is all.
Thank you for your kind attention.

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