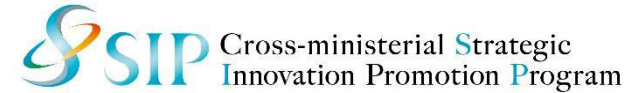


- R&D Topics : Inspection, Monitoring, and Diagnostics Technologies
- R&D Theme : Mole (Small Animals) Hole Detection System Attached to Large Weeding Machine
- Principal Investigator : Kiyoshi Suzuki (Aero Asahi Corporation)



# R&D Objectives and Subjects



## Objectives

Development of a monitoring system for the advancement on inspection of embankment utilizing the measuring system attached to a large weeding machine .

### Conventional Inspection

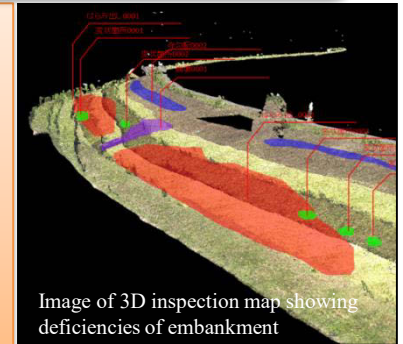


- Inspections on foot consume time and labor, despite shortage of field workers.
- Inspection accuracy depends on inspector's experience.
- Unable to conduct accurate and detailed survey, obstructed by vegetation on surface.



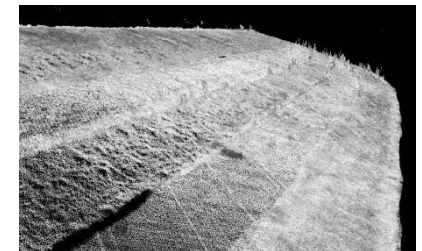
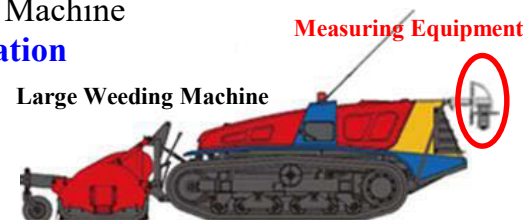
### Inspection by the New Monitoring System

- Conduct more efficient inspection and save time and effort.
- Inspect embankment more objectively and quantitatively due to detailed terrain data.
- Detailed survey of embankment will be conducted continuously at low cost.



## Subjects (2014-2016)

- Measuring Equipment easily attachable to Large Weeding Machine  
→ **Conduct accurate measurement unaffected by vegetation**
- Automatic Detection System  
→ **Detect deficiencies automatically and provide the information quickly.**
- Embankment Monitoring System  
→ **Provide the results of deficiency analysis to support field inspection**

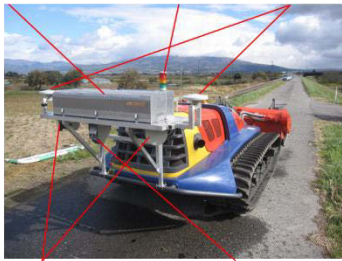


Point cloud of an embankment surface

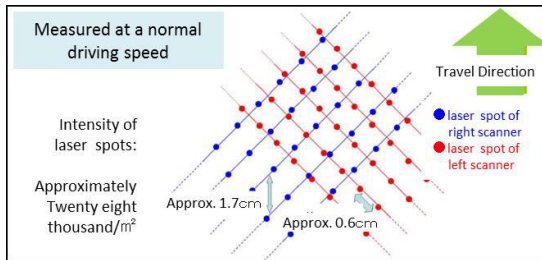
## 1. Measuring Equipment

- Developed measuring equipment that can be easily attached to the rear of a large weeding machine.

Recording unit, GNSS/IMU    Warning light    GPS antenna



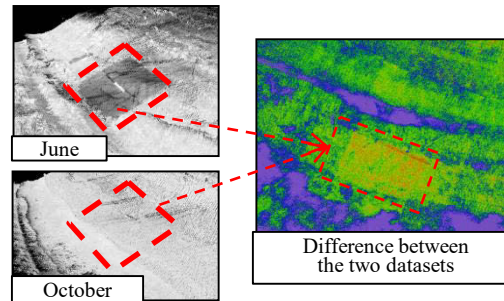
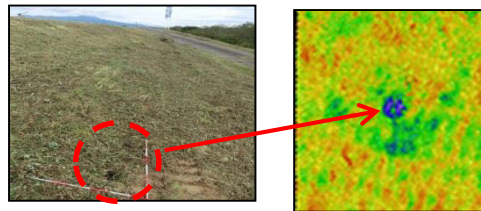
Laser scanner    Digital camera



- Acquire high-resolution terrain data simultaneously with weeding.
- Accurate and detailed measurement of embankment unaffected by vegetation

## 2. Detection Accuracy

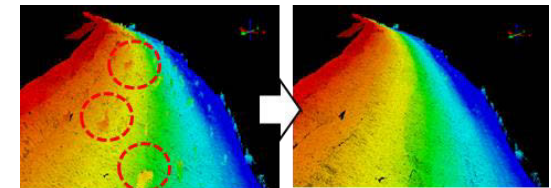
- Able to detect from small- to large-scale deficiencies, such as mole hole to depression of slope.
- Detection accuracy is superior to conventional visual inspection.



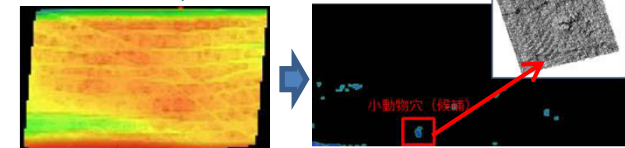
- Small- to large-scale deficiencies are detectable.

## 3. Automatic Detection System

- Developed automatic detection system of deficiencies of embankment utilizing detailed terrain data.
- Processing time was reduced to 20 hours per km of embankment by a newly developed algorithm.



Eliminating noise from large amount of point data

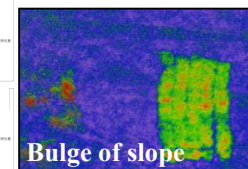
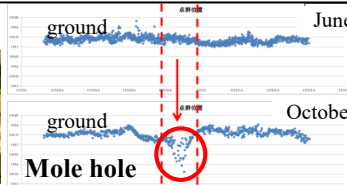


Processing for analysis  
※image of simplified process of analysis

- Time- and effort-consuming detection was automated.
- Results of analysis can be provided quickly.

### Utilization Example

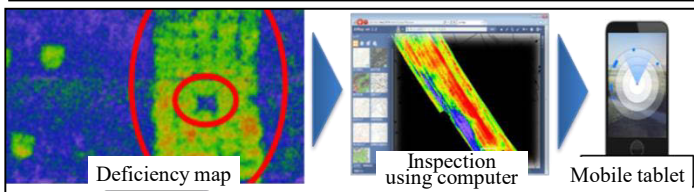
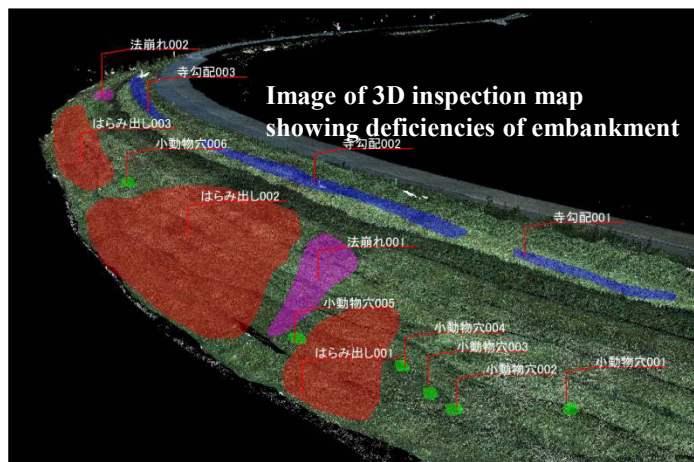
The system detected deficiencies in a test field site.



**The detection system is effective in actual field.**

## 4. Field Inspection Support System

- Developed field inspection support system which provide information on deficiencies.
- Mobile tablet with AR function.
- Cloud-based computerized inspection system



- Easier and more efficient field inspection
- More objective inspection not relying on inspector's experience.
- Upgrading future monitoring system of river embankment by a database of detailed terrain data and inspection results.

## 5. User -Friendly Operation

- Neither expert knowledge nor skill is necessary for the measurement.
- Weeding operation is not hindered, as minimum operator interaction is necessary for measurement.



- touch panel operating device (tablet or smartphone)
- user-friendly operation.
- easy-to-understand operating manual



- no operation necessary during weeding
- can be used in light rain

- Easy to introduce to the field

## Flow of utilization

### 1. Measuring Equipment

### 2. Detection Accuracy

### 3. Automatic Detection System

### 4. Field Inspection Support System

### 5. User -Friendly Operation

- Accurate and detailed measurement of embankment will be continued at low cost.
- ICT introduction to the field inspection will upgrade the future monitoring system of embankment.

## Numerical target

- Detection rate of deficiencies: 90%
- Lead time of measurement and analysis: 24 hour/km
- Installation of the measuring equipment to Large Weeding Machine: 100%

## Users

River administrators, Weeding-service providers, etc.

## How to use/Places of use

Measurements are carried out nationwide every year.

Information of detailed terrain data and inspection results of the embankment will be stored in a database and provided to users.

## Sales method

Measurements are conducted nationwide.

Measurement

- Sale or rental of the equipment
- Provide analysis services
- Inspection system royalty, etc.

Profit Creation

Inspection system operation through the Internet, etc.

- cloud workers
- senior citizens etc.

Job Creation

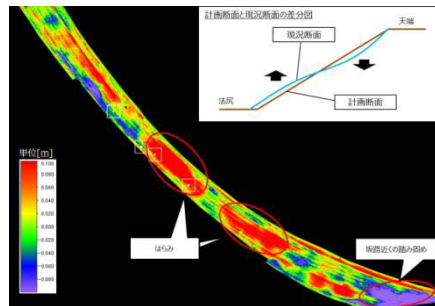
## Services to Offer

Recording unit, GNSS/IMU Warning light GPS antenna



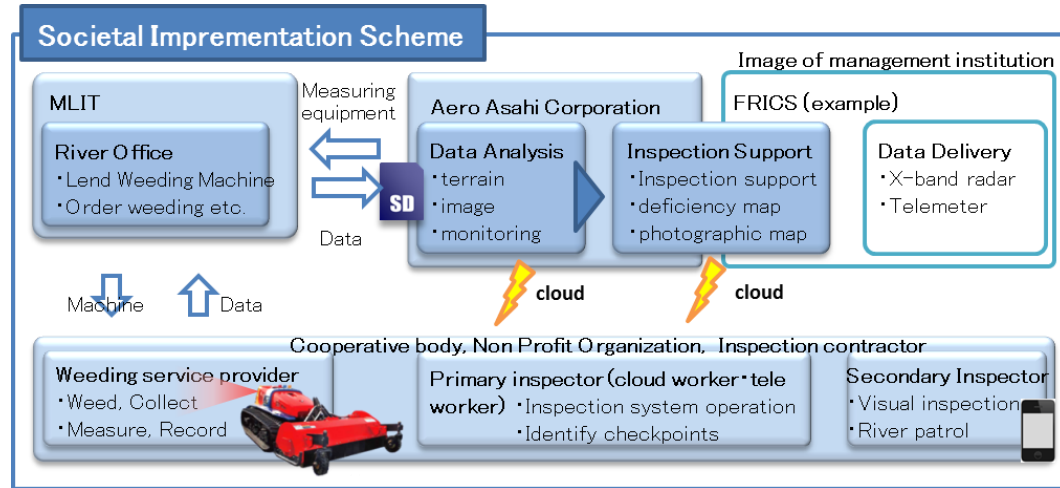
Laser scanner Digital camera

Sale or rental of the equipment



Data analysis service

**Upgrading the maintenance system of embankment**



Field inspection support service