■ **R&D Topics** : **Inspection, Monitoring and Diagnostics Technologies**
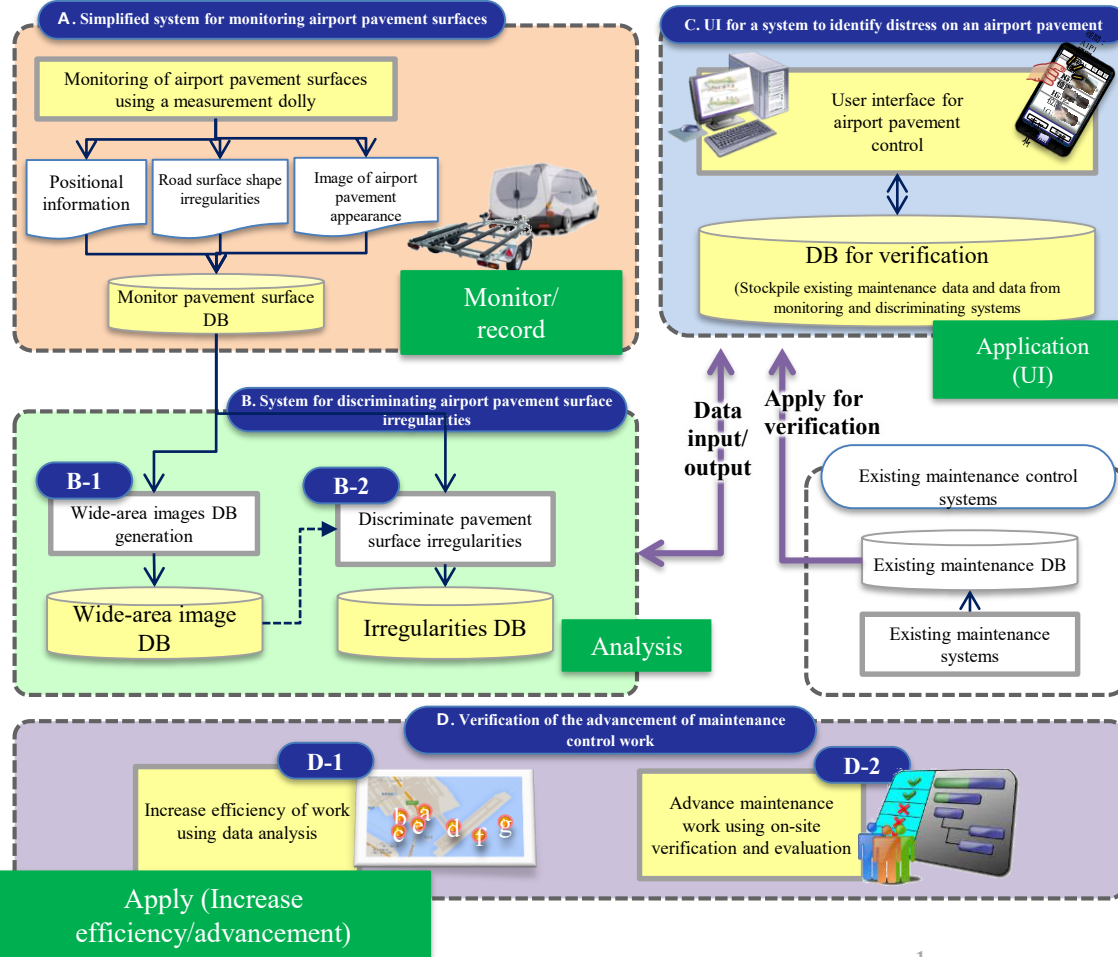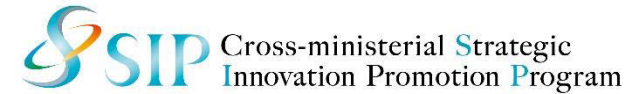■ **R&D Theme** : **R&D of a Simplified System for Monitoring the Airport Pavement Surfaces Using Maintenance Vehicles**
■ **Principal Investigator** : **Yusho Ishikawa (Professor, The University of Tokyo)**
■ **Collaborative Research Groups** : **The University of Tokyo, Pacific Consultants Co., LTD., Social Capital Design, Inc.**

# R&D Objectives and Subjects

**SIP** Cross-ministerial Strategic Innovation Promotion Program

**A. Simplified system for monitoring airport pavement surfaces**

Monitoring of airport pavement surfaces using a measurement dolly

- Positional information
- Road surface shape irregularities
- Image of airport pavement appearance

Monitor pavement surface DB

**Monitor/ record**

**B. System for discriminating airport pavement surface irregular ties**

**B-1** Wide-area images DB generation

**B-2** Discriminate pavement surface irregularities

Wide-area image DB

Irregularities DB

**Analysis**

**C. UI for a system to identify distress on an airport pavement**

User interface for airport pavement control

DB for verification
(Stockpile existing maintenance data and data from monitoring and discriminating systems

**Application (UI)**

**Data input/ output**

**Apply for verification**

Existing maintenance control systems

Existing maintenance DB

Existing maintenance systems

**D. Verification of the advancement of maintenance control work**

**D-1** Increase efficiency of work using data analysis

**D-2** Advance maintenance work using on-site verification and evaluation

**Apply (Increase efficiency/advancement)**

## Objectives

➢ **Easily visualize, record, and monitor** damage, such as the cracking of pavement, during pavement inspections by airport administrators

➢ **Understand trends in irregularities** through continuous monitoring **and use as a method of efficient maintenance control**

## Subjects

This simple pavement maintenance system comprises the following four items:

➢ **A： Simple monitoring and recording of road surfaces**

➢ **B： Discrimination of irregularities using monitoring data**

➢ **C： Provision of on-site support through visualization of maintenance data**

➢ **D： Data analysis to achieve high efficiency and more advanced work**

**Infrastructure Maintenance, Renovation, and Management**

## A. Simplified system for monitoring airport pavement surfaces
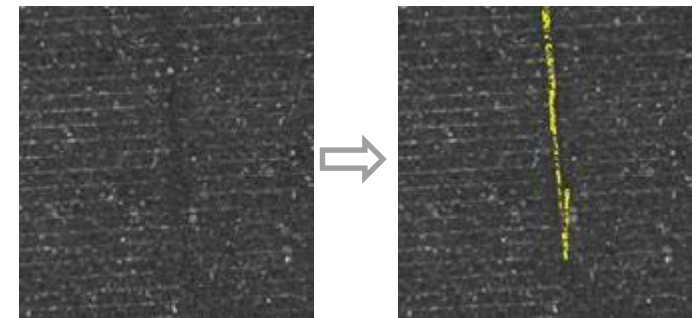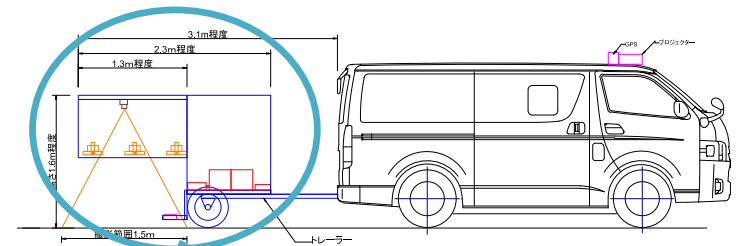
◆Technical challenges
➢ Develop easily operable system that can be operated by airport administrators
➢ Monitoring system that can acquire large amounts of detailed data over a short duration of maintenance

◆Current system conditions
➢ Develop a measuring dolly that is equipped with an optical camera, infrared sensor, and GPS device and then mount this on a vehicle owned by the airport administrators so that it can be used during pavement inspections
➢ Must be able to acquire and accumulate data and take pictures at vehicle speeds of 30 km/h

◆Ultimate goal
➢ Accurately determine surface cracks that are 1 mm or wider and deformations at vertical and horizontal resolutions of 5mm and 3cm, respectively

**Understand the run position using a GPS device with an error of 10 cm.**

## B. System for discriminating airport pavement surface irregularities

◆Technical challenges
➢ Generate wide-area images that cover the entire airstrip surface
➢ Discriminate road surface deformation to a high degree of accuracy

◆ Current system conditions
➢ Be able to integrate images from video camera to generate wide-area images that cover the entire airstrip surface
➢ Detect alligator cracks and linear cracks that are 1mm or greater from these integrated images and then record them in a database (DB) with the position they were detected in
➢ Detect and record deformations with a depth of 1cm based on the irregularity information obtained by an infrared sensor

Simplified system for monitoring airport pavement surfaces

**Camera**

**Lighting**

**On-site verification test**

Discriminate deformations while excluding grooves

**Infrastructure Maintenance, Renovation, and Management**

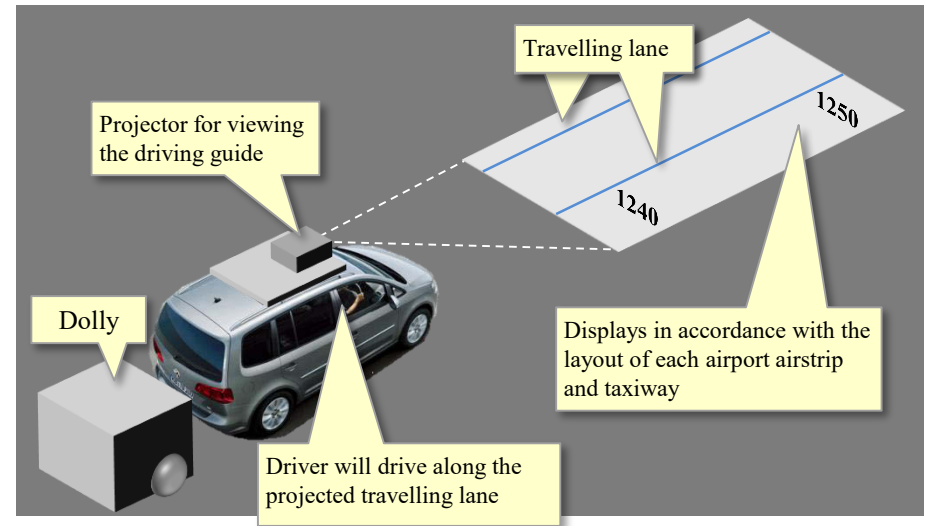## C. UI for a system to identify distress on airport pavement

◆Technical challenges
➢ Accumulate deformation data through several on-site verification tests and determine if there have been changes over time
➢ Find connections with previous data
◆Current system conditions
➢ Visualize deformations and past conditions using functions such as deformation lists, evaluation level distribution, wide-area overhead pictures, and deformation stacked viewing
➢ Administrator can refer to the same information using an office PC or an on-site tablet terminal
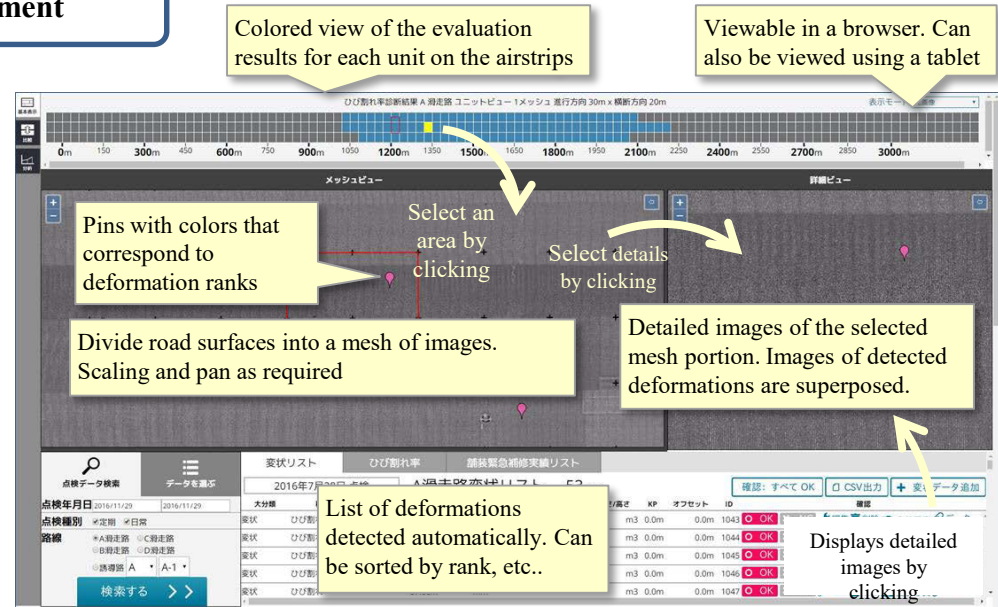
## D. Verification of the advancement of maintenance control work

◆Improving work efficiency using data analysis
➢ Use data obtained from the system to not only understand daily pavement deformation but also apply data analysis to extract deformation trends and regularity
◆Improve maintenance control work using verification data
➢ Understand on-site needs to verify efficacy of various systems
➢ Verify results from verification tests to achieve higher efficiency for procedures based on system implementation and current pavement inspections
➢ Advance on-site work by developing a guide application function that can improve the driving accuracy during monitoring

Colored view of the evaluation results for each unit on the airstrips

Viewable in a browser. Can also be viewed using a tablet

Pins with colors that correspond to deformation ranks

Select an area by clicking

Select details by clicking

Detailed images of the selected mesh portion. Images of detected deformations are superposed.

Divide road surfaces into a mesh of images. Scaling and pan as required

List of deformations detected automatically. Can be sorted by rank, etc..

Displays detailed images by clicking

Travelling lane

Projector for viewing the driving guide

Dolly

Displays in accordance with the layout of each airport airstrip and taxiway

Driver will drive along the projected travelling lane

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# Goals

## Objectives

| Application Items | Objectives |
|---|---|
| A：Simple monitoring system | Detect 1mm wide surface cracks and view deformations at horizontal and vertical resolutions of 5mm and 1cm, respectively |
| B：Deformation discrimination system | Create linking images of airstrips, display high-speed images that correspond to positions, discriminate linear/alligator cracks, and record damage type/rank/size |
| C：UI development | Create user information that can distribute deformation trends for an entire airstrip, showing fluctuation in damage rank, and understand changes in damage units |
| D：Advance maintenance control | Analyze trends such as temporal changes and spatial distributions using a deformation database. Establish work procedures with improved efficiency for pavement inspections |

## Anticipated mechanism for providing services

◆When used to perform daily pavement inspections
➢ Sell a simple pavement inspection system (with maintenance) and have the administrators use it during inspection. Provide services that advance work based on data acquired from this system
◆When used to perform periodic inspections
➢ Have service providers investigate pavement road surface characteristics during periodic inspections and then interpret, evaluate, and analyze the data and provide the results

・Service Provider

・Airport Manager

Used by administrators themselves during inspections and data is used for maintenance control

【System lease/maintenance and inspection】
・Sales, maintenance, and inspection for a simple pavement inspection system
・Perform repairs when a system malfunctions
・Improve and modify the system

【Provide services that relate to advanced maintenance control work】
・Confirm and analyze degradation trends by analyzing information collected during inspections, repair status, and usage status
・Provide proposal that will lead to improved efficiency for maintenance control work

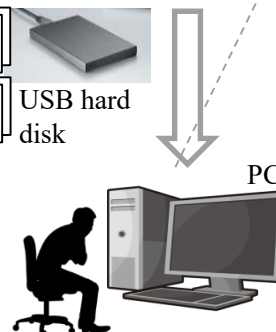Dolly used for airport control
Measuring dolly
Provided System（Installed in the office）
Viewer
Visible light videos
Infrared videos
USB hard disk
GPS data
PC
Use for urgent repairs
Increase efficiency of maintenance control work

Providing services for daily pavement inspections

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