Improving Efficiency in Maintenance of Port Facilities Using AI

(Study period: FY2018–)

Coastal Disaster Prevention Division, Coastal and Marine Disaster Prevention Department

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1. Introduction

In ports and harbors, breakwaters, quays, and other facilities are built in both land and sea areas, and some facilities extend over several kilometers. Inspections for facility maintenance require significant labor. In addition, port facilities are mainly located in the marine environment and are therefore exposed to a more severe environment compared with other civil structures. With limited human and financial resources, port managers and private companies are required to perform maintenance and management of port facilities with more efficiency and accuracy.

2. UAV Inspection and Diagnosis System

The Coastal Disaster Prevention Division utilizes new technologies such as UAVs and AI to develop an "inspection and diagnosis system for port facilities using UAVs" (UAV inspection and diagnosis system) with the aim of improving the efficiency and sophistication of maintenance of port facilities, especially general regular inspection and diagnosis, thereby reducing the burden on port managers.

The UAV inspection and diagnosis system consists of a remote image transmission system and a deformation detection system (Figure). In the system, engineers determine the degree of deterioration and evaluate the degree of performance drop based on the result of deformation detected by AI, etc.
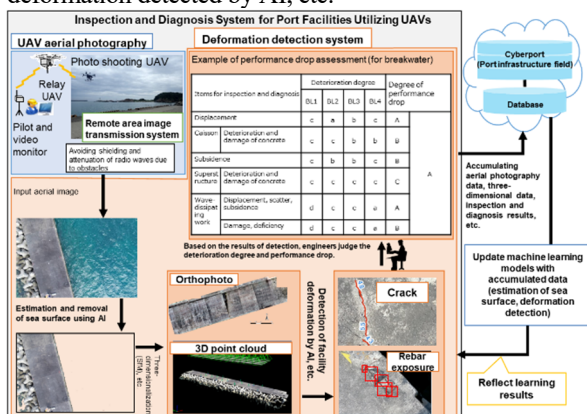

Figure: Conceptual diagram of UAV inspection and diagnosis system

3. Efficiency of Field Operations

In the demonstration experiment conducted in fiscal 2021, the field work time was reduced by about 30% (Table). Although there is some variation depending on the type and size of facilities, the experiment showed that the efficiency of field operations can be improved by using UAVs.

Table: Comparison of field operation hours

	Visual inspection (hours)	UAV photography, etc. (hours)	Time reduction percentage
Mooring facility 1	3.5	2.0	43%
Mooring facility 2	2.5	1.5	40%
Mooring facility 3	2.5	2.0	20%
Protective facility 1	3.0	1.5	50%
Protective facility 2	4.0	3.5	13%
Total	15.5	10.5	32%

Actual results in the FY2021 demonstration experiment. UAV photography includes ground mark installation and observation.

4. Future Development

Although the UAV inspection and diagnosis system is intended for use during normal times (general regular inspection and diagnosis), how the system can be utilized for inspection after a disaster will be examined in the future.

In the present UAV inspection and diagnosis system, deformation is detected by AI, etc. while the degree of deterioration and the degree of performance drop are determined and evaluated by engineers. In the future, we aim to automate the process of determining the degree of deterioration and evaluating the degree of performance drop.

✓ Click here for more information.

1) Technical report of NILIM No. 1135
   http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn1135.htm
2) Daiki Satomura: AI-based detection of sea surface and sky and detection of rust and exposed rebar with aim of more efficient inspection and diagnosis of port and harbor facilities, *AI/Data Science*, vol. 3, No. J2, pp. 360-371, Japan society of civil engineers, 2022
3) Daiki Satomura: Using UAVs and AI to improve the efficiency of inspection and diagnosis of port facilities, *Ports and Harbors*, vol. 99, No. 8, Japan Port and Harbor Association, 2022.