

## RTRI Develops Method for Constructing 3D Track Space from Camera Images

—Checking the condition of trackside equipment on a PC using video footage—

The Railway Technical Research Institute (RTRI) has developed a method for constructing a three-dimensional (3D) track space (hereinafter, “the method”), which can reproduce trackside equipment and the surrounding environment in 3D from video images taken by video cameras in the train cab.

### 1. Background

- Various types of equipment are installed along railway lines. A large amount of on-site confirmation work is required for the maintenance and management of such equipment, and this entails substantial labor, including ensuring the safety of staff during the work.
- As an alternative to on-site confirmation work, there are methods for constructing a 3D track space and identifying the condition of equipment, such as methods using point-cloud and other 3D measurement techniques. However, procedures and work such as track closure may be required in order to acquire the data, making it difficult to identify conditions over a wide area in a timely manner.
- In addition, with conventional methods using camera images, clear 3D track space could not be constructed because blind spots occur when only images in one direction, either the up track or the down track, are used (Fig. 1; hereinafter, these are referred to as “the up and down tracks”). Even when images of both the up and down tracks are used, it has been technically difficult to align the positional information and integrate them into a 3D track space.
- Therefore, there has been a need for a method that can easily and efficiently construct a clear 3D track space and identify the condition of equipment.



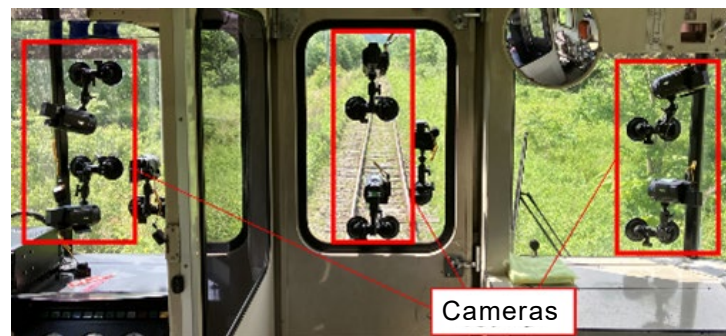
**Fig. 1: Example of a conventional method\***

\* A conceptual view of a 3D track space constructed only from images in the up-track direction, as seen from the down-track direction

### 2. Outline of method

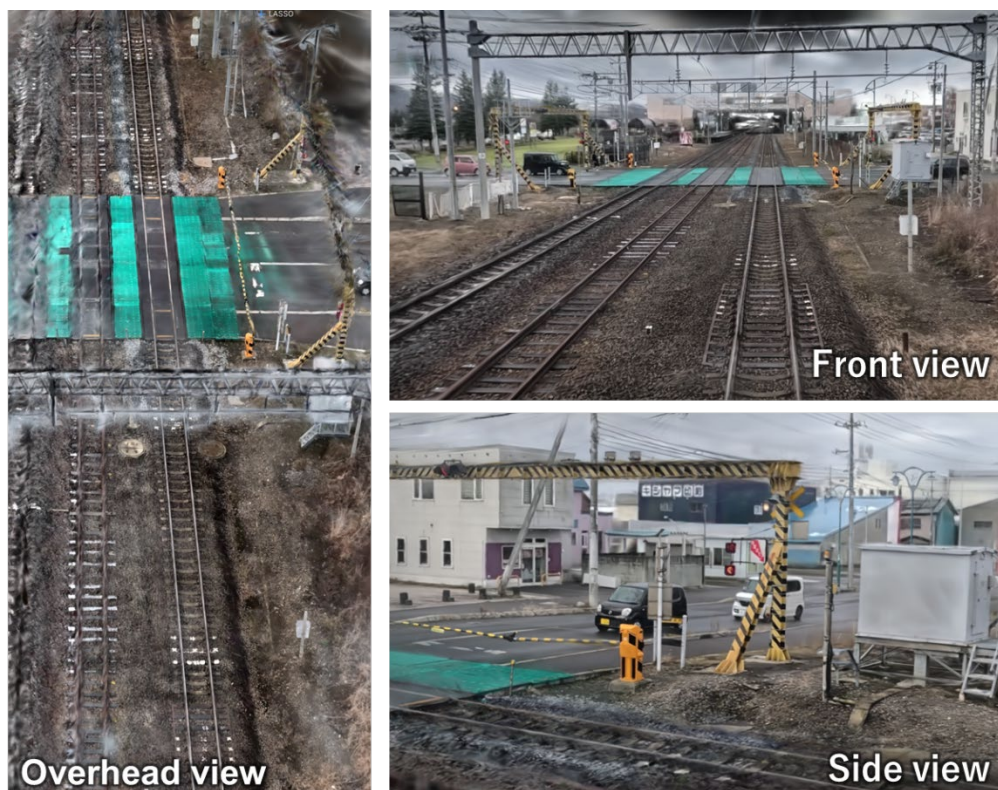
- The method creates the 3D track space from video images of the up and down tracks recorded by commercially available video cameras.
- Video cameras installed in the cabs of in-service trains are used to record the up and down tracks (Fig. 2).

- Recorded video taken while trains are running at the maximum speed of 130 km/h on conventional lines can also be used.



**Fig. 2: Example of recording with video cameras**

- Video images obtained while running on the up and down tracks are integrated to create a 3D track space on a PC.
- By importing video images from runs on the up and down tracks into a PC and integrating them by aligning positional information using AI-based deep-learning image-matching technology, trackside equipment can be clearly reproduced from all directions (front, side, and overhead views) (Fig. 3).



**Fig. 3: Example of a 3D track space constructed by integrating images of the up and down tracks**

### 3. Examples of use

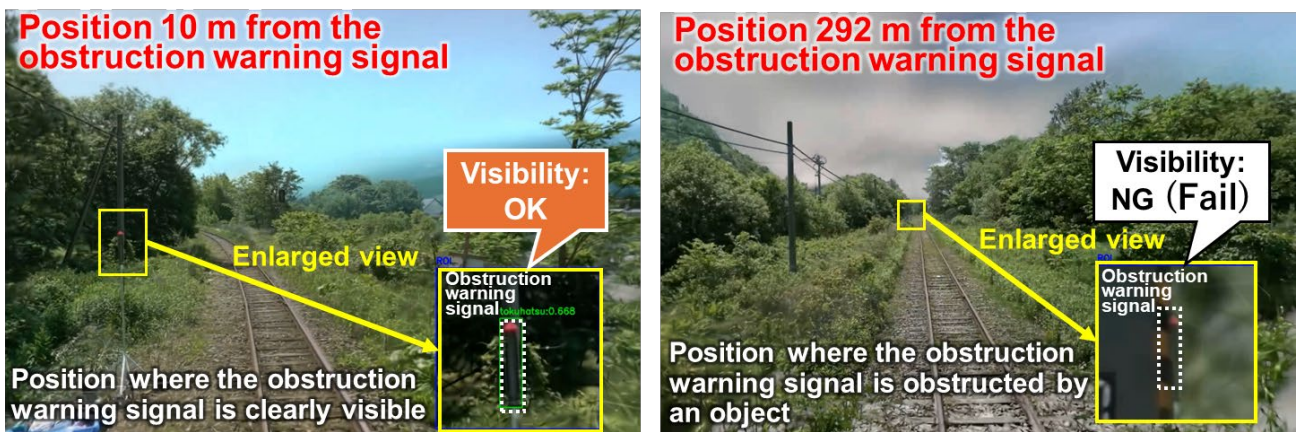
- Using the constructed 3D track space, the condition of equipment can be identified while working in an office or other location, without going on-site.

#### (1) Identifying the condition of trackside equipment

Using video recorded from in-service trains, the external appearance of trackside equipment such as signal equipment boxes, as well as the inclination of poles and other structures, can be identified frequently with little labor. The method can also be used for purposes such as construction planning.

#### (2) Checking the visibility of obstruction warning signals

When this method was applied to the AI-based visibility check system for obstruction warning signals that RTRI has already developed, the positions where the visibility was determined as unacceptable could be identified with a distance error of approximately 1% (Fig. 4).



**Fig. 4: Verification test results of the visibility check system for obstruction warning signals (examples of visibility for the same obstruction warning signal)**

### 4. Future applications

RTRI will continue to collaborate with railway operators to conduct verification tests with a view to implementing this method in practice.

In parallel, RTRI will work to expand the application of this method to existing systems such as the visibility check system, thereby supporting labor-saving in the maintenance and management of railway trackside equipment.