

RTRI Develops Wooden Sleeper Deterioration Evaluation System

The Railway Technical Research Institute (RTRI) developed Wooden Sleeper Deterioration Evaluation System based on a deep learning technique that uses images captured with a video camera installed on the front window of the leading car of a train running on, e.g., a commercial line. The system can automatically determine the degree of deterioration of wooden sleepers such as corrosion and cracking (Fig. 1). The system will enable wooden sleeper conditions to be determined even if track maintenance engineers do not go to the site and improve efficiency in determining the degree of deterioration of wooden sleepers, including increasing inspection speed, and saving labour and costs.

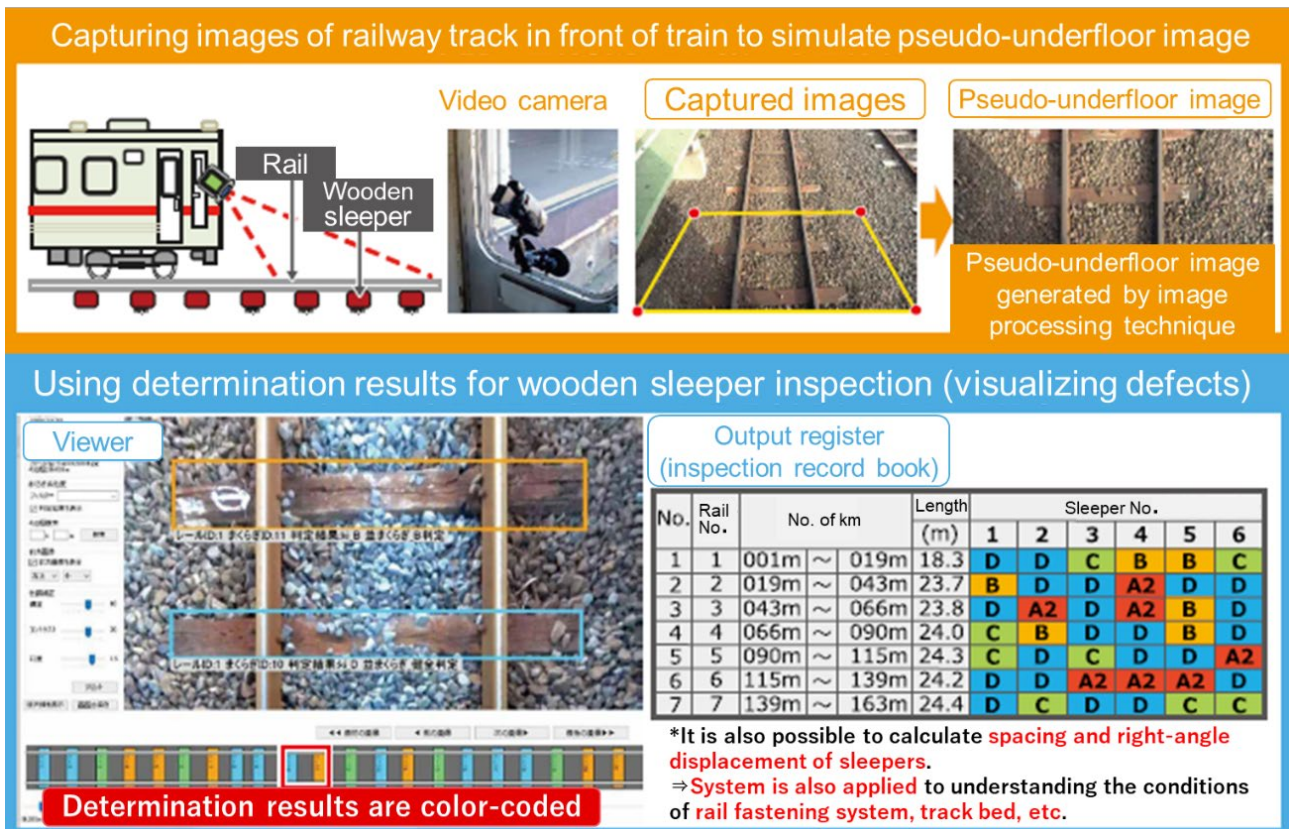


Fig. 1 Wooden Sleeper Deterioration Evaluation System

1. Background of Development

On sections of railway lines constructed mainly of wooden sleepers, successive defects of sleepers as shown in Fig. 2 may cause the rail fastening force to decrease and gauge to widen during travel, which can consequently cause derailment.



Fig. 2 An example of a sleeper defect

As a countermeasure for this, track maintenance engineers walk on railway tracks and perform external visual inspection or hammering inspection of one wooden sleeper at a time to determine the presence or absence and the degree of defects (deterioration). However, there was a problem with this method in that it requires significant effort and judgments based on professional knowledge and experience to inspect enormous numbers of sleepers.

2. Overview and benefits of the system for determining the degree of deterioration of wooden sleepers

This system for determining the degree of deterioration of wooden sleepers uses a video camera (with a resolution of 4K or higher) to convert an image of railway tracks taken from a window of the leading car (from inside of the car) of a train running on, e.g., a commercial line into an image taken from the above (under-floor image). Then, we apply our own algorithm using image processing and deep learning to extract wooden sleepers, and automatically assign determination results and location of deterioration (kilometrage) to each sleeper.

Since this system uses images captured with a video camera installed on a train running on a commercial line, and the like, it has become possible to determine the degree of deterioration in a short time and improve inspection efficiency, with no need for track maintenance engineers to go to the site. Moreover, as commercially-available video cameras suffice, the system can be implemented at low cost.

- The degree of deterioration is determined on four-level determination criteria. Our tests confirmed that the deterioration determined with this system was 90% or more identical to that visually assessed by track maintenance engineers (Fig. 3).
- Determination results can be verified with specialized software “Makuragi Viewer (Sleeper Viewer)” (Fig. 4) and can be output in the spreadsheet-style form of an inspection record book. With this viewer and record book, determination results for each sleeper can be output in a colour-coded format to denote the degree of deterioration,

making it easy to identify the degree of deterioration and areas where successive defects occur.

- Our Sleeper Viewers are equipped with functions to search kilometrage, enlarge images, measure lengths, and calculate angles, and therefore, the viewers can be used to determine the degree of deterioration of wooden sleepers, confirm conditions of given sleepers and rail fastening systems, and the like, as well as to measure tie spacing and right angle displacement (rotation of sleepers installed at right angles to rails) of sleepers.

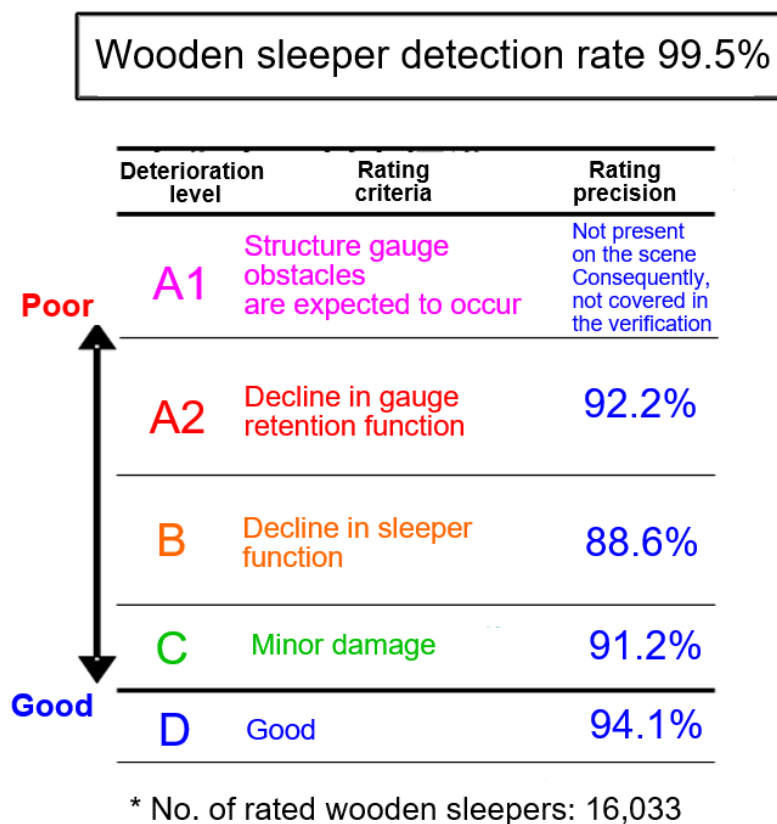


Fig. 3 Rating precision of this system



Fig. 4 Screen displaying determination results obtained from the Sleeper Viewer

3. Miscellaneous

This system has been tried by a number of railway operators and will be generally available within the year.

The design of the display image on the Sleeper Viewer has been registered (Japanese Design Registration Number 1688642).