

Development of Concrete Diagnostic System Employing Infrared Camera and CCD Camera

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The exfoliation and falling of concrete linings due to material deterioration or defective work has become a problem. Hammering inspection has been commonly applied to check concrete structures for defects. However, since there are a very large number of concrete structures that need to be checked, the inspectors have a significant burden.

RTRI has developed a diagnostic system that permits the accurately judging of the conditions of anomalies of concrete structures by the combination of images obtained by an infrared camera and a CCD camera. The system offers a new inspection method that is more efficient than hammering inspections.

The system consists of an infrared camera, a CCD camera, a laser range finder and an angle meter (for measuring angle of elevation and angle of deviation). It allows for high-accuracy image processing through integration of the positional information obtained by the range finder and angle meter, the pre-registered information about the infrared camera/CCD camera lenses (aberration and parallax of each lens), etc.

For structures in an open section, such as elevated rigid-frame bridges, the high-sensitivity infrared camera permits checking by a day's change in outdoor temperature alone. In addition, when this system is employed in active infrared thermography, it significantly widens the scope of application of the technique.

The system has been developed specifically for engineers who work at the front line. Therefore, the system is not only easy to use but also provided with application software that permits smoothly executing the inspection, judgment and reporting operations. The main functions of

the system are as follows.

- Images obtained by the infrared camera and CCD camera are instantaneously overlapped and displayed on the monitor screen. The density ratio of thermographic and visible images can be set arbitrarily, facilitating judgment on whether the temperature difference shown on the monitor screen is due to the loosening of concrete or whether it indicates loosening of concrete due to cracking.
- By means of orthographic projection (elevation correction) of an image, the image can be automatically transformed into one that was obtained as if it were taken from the right front of the structure.
- By tracing defective concrete parts (loose or cracked parts) displayed on the monitor with the touch pen or mouse, it is possible to automatically measure and calculate their areas and lengths and prepare a list of defective parts.
- The function that displays thermographic images with emphasis on temperatures permits displaying only desired temperature zones in different colors.

The system has made it possible to efficiently and accurately detect the presence and development of loosening or cracking of concrete that can lead to concrete exfoliation in the future, thereby improving the safety of third parties against disasters dramatically.

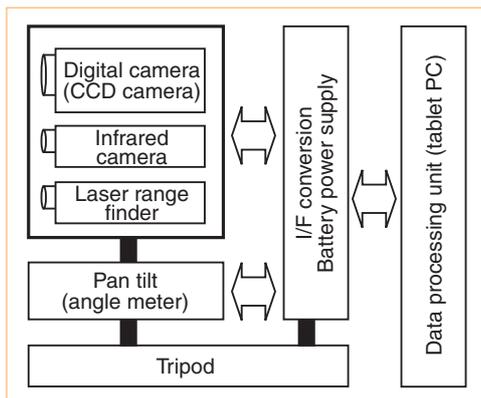


Figure 1. System configuration

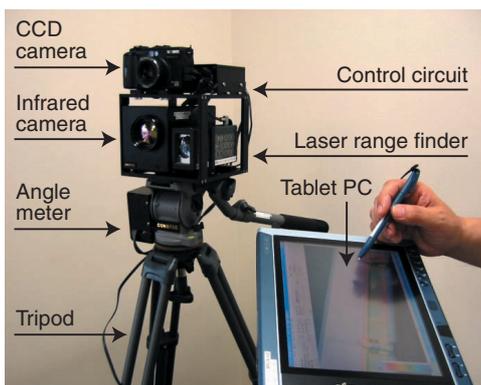


Figure 2. Appearance of system

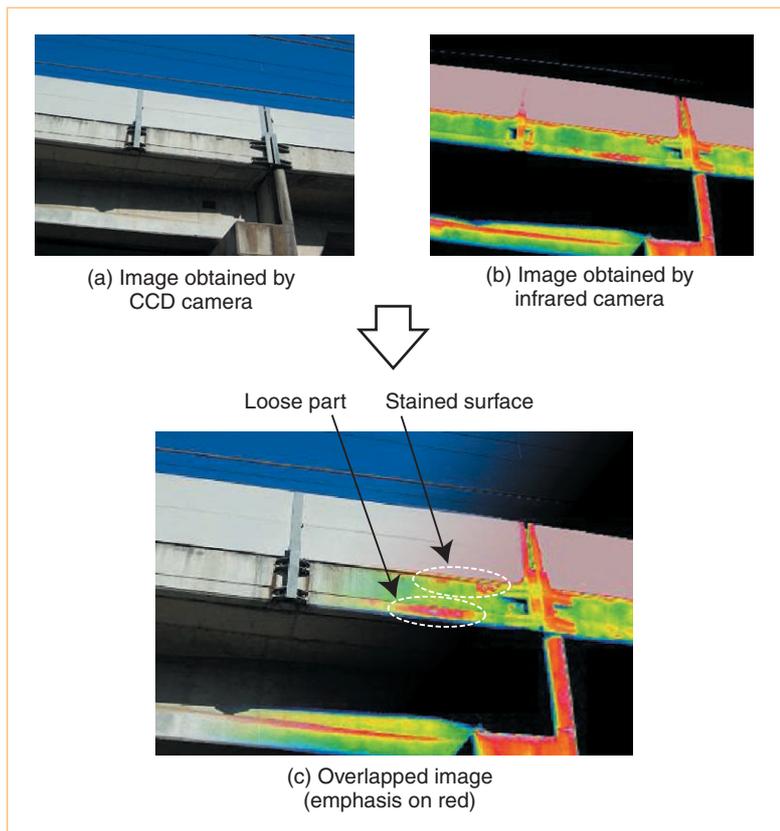


Figure 3. Examples of overlapped images