Monitoring system for safety management of structures using elastico-luminescent materials

Real-time visualization of the shape distribution and propagation of cracks using elastico-luminescent sensors

We have developed a monitoring system that enables the visualization of the shape distribution and propagation of cracks in concrete by employing elastico-luminescent sensors. The safety-management monitoring system we have developed includes elastico-luminescent sensors that emit light upon mechanical stimulation (elastico-luminescence), image sensor nodes that monitor the distribution of luminescence intensity of the elastico-luminescent sensors, wireless photo detector nodes, a database for diagnosing the stress anomaly in the structure on the basis of the luminescence intensity, and a network system that coordinates the operation of these components. The appearance of a crack that occurs in the concrete of bridges and buildings is visualized by using this system, when the elastico-luminescent sensors of the system are placed on the structure surfaces. Moreover, we can predict the generation and propagation of the crack by diagnosing the stress anomaly in the structure. This monitoring system based on elastico-luminescence is expected to be used for inspection and maintenance of various structures including those made of concrete.

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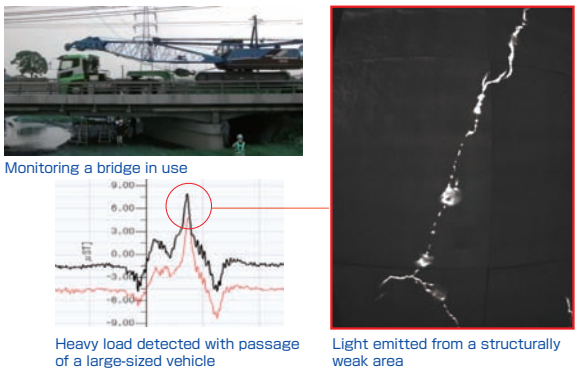

The safety-management monitoring system inspecting a bridge
In monitoring a bridge in use (top left), when a large-sized vehicle passed and a heavy load was added, abnormal image of elastico-luminescence was recorded.

Precise distribution system for frequency standard through optical fiber

Expectation for application to many areas as calibration, measurement, particle physics, and radio astronomy

A precise frequency transfer system using optical fiber has been developed. The purpose of the system is to distribute frequency standard with little deterioration to many distant users. It is composed of a phase compensation transmitter, bidirectional optical amplifiers, an optical distributor, and optical receivers. The system target is to achieve a stable transmission of hydrogen maser class signals. For short term stability, it shows the required optical received power to realize the Allan deviation of 1×10^{-13} (averaging time of 1 s). For long term stability, a new compensation method using dense wavelength division multiplexing signals is effective to suppress phase fluctuation induced by fiber temperature change. Experimental results show stability of 8×10^{-17} at 10^5 s in a fiber link of 160 km in total with one bidirectional optical amplifier. This system is expected to be useful in a wide variety of areas such as calibration, measurement, particle physics, and radio astronomy.

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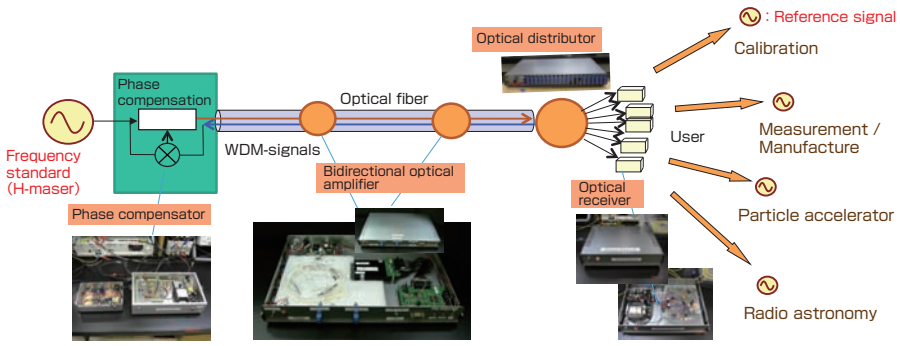

Main devices for precise frequency distribution system with optical fiber and its fields of application