Effective Design of Automatic and Real-time Bridge Monitoring System

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Summary

A prototype system has been developed that incorporates a previously proposed design of a system that remotely monitors a bridge in real time and that provides a valuable source of information for managing response to a natural disaster, maintaining its structure, and estimating the extent of structural fatigue. The system consists of various sensors, high-speed data transmission networks, and an information centre that collects and disseminates high-level information on how well a bridge performs. A prototype system for monitoring the Metropolitan expressway in Tokyo, Japan, that has a lot of excessively-loaded heavy vehicles, has been developed, and it was found to be both reliable and durable.

Keywords: real-time bridge health monitoring; fiber-optic sensor; automatic information system.

1. Introduction

In recent years, highway bridges in Japan have suffered various kinds of damage, e.g., fatigue, corrosion, and abrasion, which have been worsened by the continual passing of excessively-loaded heavy vehicles. There is a risk of a serious disaster in the event of an earthquake or accident occurring in the vicinity of bridges that are already weakened through damage. If a disaster like this were to occur in a densely populated area such as Tokyo, the effects could be catastrophic.

According to seismic experts, there is a high risk of a big earthquake occurring in Japan in the immediate future. In such an event, the establishment of secure road networks is a key factor for ensuring public safety and preventing economic losses. One of the most important pieces of information that we need is whether vehicles, especially emergency and transport vehicles that bring in relief supplies, can pass over the bridge or not. However, getting this information generally takes several hours because it is done by someone at the location. Therefore, if a monitoring system could remotely check the integrity of several bridges instantaneously and simultaneously, it would substantially reduce both social and economic losses.

Furthermore, the interval between regular inspections of Japanese highway bridges is typically five years, which is often not frequent enough for the early detection of damage and, if necessary, scheduling of appropriate maintenance. Therefore, if a monitoring system could automatically detect changes in the daily basic motions of bridges, e.g., the vibration of the girders, between regular inspections, this information would enable scheduling of maintenance well in advance of the next regular inspection.

Information technology has already contributed greatly to remarkable development in how bridges are maintained, and it has enabled the handling of a great deal of data quickly and efficiently. It has been mainly brought about by high-speed processing technology that enables data to be transmitted at high-speed and stored in large amounts.

We propose a system for monitoring bridges that is based on the use of advanced information technology to automatically monitor bridge motion. Data on this motion enables road/bridge

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