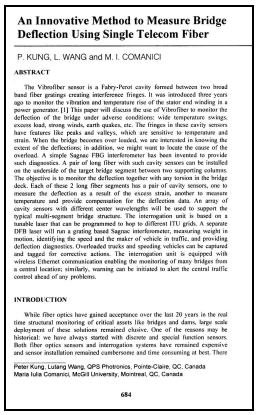

An Innovative Method to Measure Bridge Deflection Using Single Telecom Fiber

P. KUNG, L. WANG and M. I. COMANICI

ABSTRACT

The Vibrofiber sensor is a Fabry-Perot cavity formed between two broad band fiber gratings creating interference fringes. It was introduced three years ago to monitor the vibration and temperature rise of the stator end winding in a power generator. [1] This paper will discuss the use of Vibrofiber to monitor the deflection of the bridge under adverse conditions: wide temperature swings, excess load, strong winds, earth quakes, etc. The fringes in these cavity sensors have features like peaks and valleys, which are sensitive to temperature and strain. When the bridge becomes over loaded, we are interested in knowing the extent of the deflections; in addition, we might want to locate the cause of the overload. A simple Sagnac FBG interferometer has been invented to provide such diagnostics. A pair of long fiber with such cavity sensors can be installed on the underside of the target bridge segment between two supporting columns. The objective is to monitor the deflection together with any torsion in the bridge deck. Each of these 2 long fiber segments has a pair of cavity sensors, one to measure the deflection as a result of the excess strain, another to measure temperature and provide compensation for the deflection data. An array of cavity sensors with different center wavelengths will be used to support the typical multi-segment bridge structure. The interrogation unit is based on a tunable laser that can be programmed to hop to different ITU grids. A separate DFB laser will run a grating based Sagnac interferometer, measuring weight in motion, identifying the speed and the maker of vehicle in traffic, and providing deflection diagnostics. Overloaded trucks and speeding vehicles can be captured and tagged for corrective actions. The interrogation unit is equipped with wireless Ethernet communication enabling the monitoring of many bridges from a central location; similarly, warning can be initiated to alert the central traffic control ahead of any problems.

INTRODUCTION

While fiber optics have gained acceptance over the last 20 years in the real time structural monitoring of critical assets like bridges and dams, large scale deployment of these solutions remained elusive. One of the reasons may be historical: we have always started with discrete and special function sensors. Both fiber optics sensors and interrogation systems have remained expensive and sensor installation remained cumbersome and time consuming at best. There

Peter Kung, Lutang Wang, QPS Photronics, Pointe-Claire, QC, Canada
Maria Iulia Comanici, McGill University, Montreal, QC, Canada

Код: 10323

P. Kung, L. Wang, M.I. Comanici

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Ключевые слова:

Содержание.