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Method for Validation of long-term Temperature Measurements from Sensors

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Abstract

Structural Health Monitoring (SHM), which holds promise for quick and reliable assessment of structural condition, requires reliable long-term measurements. While commercially available sensors can provide accurate measurements, none have been tested on longer timescales to ensure stability. This study deals with the creation of a method for the validation of temperature measurements without the use of a redundant monitoring system. Reliability of temperature measurements is particularly important because they are often used for the compensation of other measurements, such as strain. The method is based on comparison of measurements to easily obtainable public data, such as data from meteorological agencies, and is presented through application to measurements from sensors installed on Streicker Bridge in Princeton, NJ. It was successfully used to confirm stability of multiple sensors and detect malfunction of other sensors.

Keywords: structural health monitoring, temperature validation, FBG sensors, long-term monitoring, temperature measurements, measurement drift

1 Introduction

With aging infrastructure, methods for assessment of long-term performance of structures are becoming increasingly important. Structural Health Monitoring (SHM) has the potential to aid in long-term monitoring of structures. However, for SHM to provide reliable conclusions, reliable long-term data must be collected and validated.

Temperature measurements are increasingly used in temperature-driven SHM methods to understand structural response to thermal variations, which in many cases exceed the responses due to live load [1– 2]. Additionally, temperature measurements are frequently used to compensate other types of measurements, such as strain measurements, that are heavily influenced by temperature variations. Thus, validation of long-term temperature measurements is important to guaranteeing reliability and accuracy of strain-based and other temperature-driven methods of analysis.

Although stable and accurate sensors currently exist on the market, such as fiber optic sensors, their long-term performance has not been tested in harsh field conditions typical of civil engineering applications, such as embedment in the concrete. Such conditions can result in damage to packaging components over time, affecting the accuracy of collected measurements.

This paper presents a validation method for long-term temperature measurements that relies on the use of publicly available ambient weather data from nearby meteorological stations. The method examines the relationship between ambient

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