# Long term dynamic monitoring of a PSC box girder bridge

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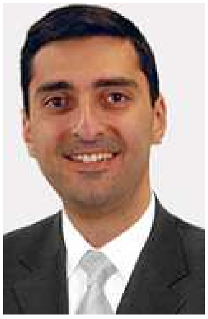

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## Summary

Structural Health Monitoring (SHM) aims to determine whether damage is present or not based on the analysis of measured dynamic characteristics of a monitored system. Normal changes are usually caused by modifications in environmental conditions such as humidity, wind and most important, temperature. Conversely, abnormal changes are generally caused by the presence of damage i.e. loss of structural mass and/or stiffness. This paper reports on the effect of temperature changes on the natural frequencies of the PI-57 motorway bridge located at Senlis, France. Dynamic measurements were carried out during almost two years and the goal is to develop a methodology for separating environmental influences from possible damage events. Hence, several regression and model fitting methods are used such as multiple linear regression and neural networks. It is observed that possible structural modifications show up as outliers in the statistical frequency-temperature relations.

**Keywords:** Structural health monitoring, regression analysis, temperature effects.

## 1. Introduction

In the past years, numerous methods for structural damage assessment were proposed in the literature. The simplest (but not necessary the easiest) objective is to determine whether a structure presents an abnormal behaviour or not. A feature sensitive to damage is a quantity extracted from the measured system’s response that is able to indicate the presence of a structural modification. Identifying features that can accurately distinguish a damaged structure from an undamaged one is the focus of most SHM techniques [1]. Fundamentally, the feature extraction process is based on fitting some model, either physics-based or data-based, to the measured system’s response. The parameters of these models or the predictive errors associated with them become the damage-sensitive features.

One of the most common methods of feature extraction comes from correlating observations of measured quantities with posterior observations of the degrading system. Many techniques have been proposed to locate and quantify damage considering deviations in the structures' modal parameters [2]. These methods usually determine the baseline parameters through acquisition of forced or ambient vibration test data. Damage detection is then based on the principle that damage in the structure will produce changes in the measured vibration data. Most of these techniques, however, neglect the important effects of environmental changes on the original structure. Modifications in load, boundary conditions, temperature and humidity can have a significant effect on the original modal parameters of large civil structures. In fact, sometimes these variations can be

https://doi.org/10.2749/222137810796025492
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