Using heterogeneous measurement data to update the corrosion degree in bridge girders

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Abstract

Existing concrete bridges can show signs of deterioration, e.g. due to corrosion, in which case the question arises whether these bridges still have an acceptable safety level. To obtain additional information about the state of the structure, different types of information can be gathered. However, the measurements performed are often not used directly to update the estimate of the corrosion degree of the bridge and the resulting information from different measurement types is not combined. In this contribution, it is investigated how parameters of the service life models for concrete girders subjected to chloride-induced corrosion can be updated based on heterogeneous measurement data, with the focus on modal measurements and strain measurements. The posterior distributions of these parameters are generated based on Bayesian updating. These updated distributions can be used to get a more accurate estimate of the real deterioration state of the bridge. Based on this, the failure probability of the bridge and its remaining service life can be estimated more accurately.

Keywords: Concrete degradation, Corrosion, Bayesian updating, Structural Health Monitoring.

1 Introduction

Monitoring and inspection of structures are important aspects for estimating their remaining lifetime and for supporting decisions on maintenance and repair. In Belgium, current practice in managing bridge patrimony is based on structural assessment by visual inspections and deflection measurements. These assessments indicate whether parts of the bridge are suffering from degradation and whether unexpected deformations have taken place. Also strain measurements are often applied. However, there is a lack of knowledge on how to use these results in acquiring a better estimate of the remaining lifetime of the structure. Besides, structural health monitoring techniques based on modal analyses also gain importance in bridge inspection [1,2]. Although databased methods seem promising for detecting structural anomalies, they cannot be used to quantify their remaining lifetime. Hence, when prediction of the remaining lifetime of a structure is required, model-based methods might be more appropriate [3]. In these methods, the model simulating the (time-dependent) behaviour of the structure is updated based on measurement outcomes.

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