A fiber optics enriched Digital Twin for assessment of reinforced concrete structures

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Abstract

This paper presents the results of *SensIT*, an ongoing research initiative at Chalmers University of Technology aimed at developing a digital twin concept to improve the asset management strategies of reinforced concrete infrastructure. The developed concept relies on data collected from distributed optical fiber sensors (DOFS), which are then analysed to extract relevant features, such as deflections and crack widths, that can be used as indicators of the structural performance. Thereafter, intuitive contour plots are generated to deliver critical information about the element's structural condition in a clear and straightforward manner. Last, both raw and analysed data are integrated into a collaborative web application where information can be readily accessed, and results can be visualized directly onto a 3D model of the element. The concept has been tested on a large-scale reinforced concrete beam subjected to flexural loading in laboratory conditions.

Keywords: Digital Twin; Reinforced Concrete; Distributed Optical Fiber Sensing; Rayleigh Backscattering; Performance indicators; Crack monitoring; Assessment.

1 Introduction

Maintaining the performance of our transport infrastructure is crucial to sustain all societal activities, to guarantee the travelers safety and to ensure the welfare of society. However, the advanced age of many existing structures added to ongoing degradation processes and the ever-increasing level of demands in terms of traffic loads, represent a major challenge. Consequently, condition assessment and proper maintenance are imperative to ensure the integrity and the serviceability of our infrastructure. Yet today, condition assessment strategies rely on labor-intensive and time-consuming on-site inspections, providing limited and subjective data. In addition, maintenance operations are disruptive and costly, representing a major part of the recurrent infrastructure cost in developed countries. Moreover, common structural assessment practices often deal with large uncertainties. Indeed, on-site inspections provide information

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