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Structural Health Monitoring of RC structures using optic fiber strain measurements: a deep learning approach

Dimitrios F. KARYPIDIS
M.Sc. Student
Chalmers University of Technology
Gothenburg, Sweden
dimkary@student.chalmers.se

Last year student at the Master Program Complex Adaptive Systems and research assistant in machine learning applications in civil engineering

Carlos G. BERROCAL
PhD
Chalmers University of Technology
Gothenburg, Sweden
carlos.gil@chalmers.se

Postdoctoral researcher in the field of durability of RC and structural monitoring currently working on digitalization of transport infrastructure

Rasmus REMPLING
Associate Professor
Chalmers University of Technology
Gothenburg, Sweden
rasmus.rempling@chalmers.se

Researcher in the field of Structural and Construction Engineering with interest in AI based and automated processes.

Mats GRANATH
Associate Professor
University of Gothenburg
Gothenburg, Sweden
mats.granath@physics.gu.se

Background in theoretical condensed matter physics and complex systems and researcher in AI based systems.

Peter SIMONSSON
PhD
Swedish Transport Administration
Luleå, Sweden
peter.simonsson@trafikverket.se

Bridge expert in a client organization and researcher in construction engineering and building processes.

Contact: carlos.gil@chalmers.se

1 Abstract

This paper reports the early findings of an ongoing project aimed at developing new methods to upgrade the current maintenance strategies of the civil and transport infrastructure. As part of these new methods, the use of Machine Learning (ML) algorithms is being investigated to constitute the core of a new generation of more accurate and robust structural health monitoring (SHM) systems for concrete structures. Unlike most of the existing SHM systems, relying on the analysis of the natural frequencies of the structure based on data obtained from accelerometers, the present study uses a distributed optic fiber system to monitor the strain distribution along steel reinforcing bars. The preliminary results of the study indicate that a semi-supervised Deep Autoencoder algorithm (DAE) can successfully quantify the damage attributable to transverse cracks in a reinforced concrete beam subjected to three-point loading. Future applications will feature the determination of crack locations, early detection of reinforcement corrosion as well as other types of damage such as splitting cracks or surface spalling.

Keywords: structural health monitoring, machine learning, deep autoencoders, anomaly detection, concrete structures, distributed optic fiber.

2 Introduction

Recent advancements in digital technology and communications have rendered possible the use of real-time monitoring systems, which constantly receive, process and analyze streams of data obtained from distributed sensor networks. Handling and using big streams of data is a tedious task, which has occupied data scientists for the past years. One of the most promising tools for handling

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