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1-D CNN deep learning of smart aggregate's impedance signal for concrete stress monitoring

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ABSTRACT

Stress monitoring is essential for assessing the safety and performance of concrete structures. The traditional impedance-based method for estimating the concrete stress requires multi-steps and is not automated. Further, the selection of hand-crafted impedance features could cause the difficulty in quantitative stress evaluation and the false damage alarm. Thus, this study proposes a 1-D CNN regression model for autonomously monitoring stress in concrete specimens utilizing the raw impedance signatures of smart aggregate (SA) sensors. Firstly, the fundamental theory of the impedance measurement model of SA is presented. Secondly, the compression experiment on SA-embedded concrete cylinders is carried out, and the impedance signals of the cylinders are recorded under different stress levels. Thirdly, the 1-D CNN regression model learned the impedance signals for predicting the concrete stress is constructed. Finally, the average performance of the proposed model is verified via the 10-fold cross-validation method. The feasibility of the developed model is investigated under the effect of noises in signals and reduction of the input training data.

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