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## Nondestructive structural monitoring of bridges based on artificial intelligence

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### ABSTRACT

Non-destructive measurement techniques have been used for decades to assess the deterioration of various critical infrastructure such as bridges. The cause of deterioration does not have to be overload, resulting from increasingly frequent extreme weather conditions, but rather more and more intensive road traffic with an ever-increasing number of heavy transport vehicles. In addition, reinforced concrete often undergoes destructive chemical processes (e.g., alkali silica reactions), which significantly affect the progressive degradation of its mechanical properties.

The lack of the need to take physical samples, which by cutting, leads to local damage to the structure, is one of the biggest advantages of nondestructive solution, here considered. In addition, the possibility of assessing the quality of the structure on site saves time necessary for laborious analysis of results or laboratory strength tests of many material samples. However, in order to be able to assess the technical condition of any structure, one must first prepare a full measurement procedure, choose the best location for mounting the measuring sensors, correctly collect all measurement data and consistently interpret the results, and also have an a priori calculation model to be used in the identification procedure.

In this paper, it is assumed that the identification procedure is already known. The structure of the investigated bridge is also known and the computational model of a specific bridge is already built and precisely reflects the behavior of the structure. Here, the focus is on finding the best method to build a substitute model, whose task is to quickly determine in situ the technical condition of the structure. For this purpose, various techniques of creating surrogates based on artificial neural networks are used. From the simplest construction of shallow networks to more advanced Bayesian networks and networks with radial basis functions. The effectiveness of the substitute models is checked on synthetic data and verified on the example of literature data.

**Keywords:** artificial intelligence, characterization procedure, concrete bridge, nondestructive structural monitoring.