Reliability Assessment of Long-Span Cable-Stayed Bridges Based on a Hybrid Algorithm

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Keywords: *Bridge Engineering; Cable-Stayed Bridge; Hybrid Algorithm; Neural Network; Reliability Index; Safety Assessment; Parameter Sensitivity*

Abstract

In order to analyze the reliability of long-span prestressed concrete（PC）cable-stayed bridges, a hybrid algorithm, which applies to complex constructions such as long-span PC cable-stayed bridges is proposed. The method combines finite element analysis (FEA), radial basis function (RBF) neural network, genetic algorithm (GA) and Monte-Carlo importance sampling method (MCIS), some critical steps like initial sample points design method of RBF neural network, MCIS sampling center position in the algorithm are modified so that structural analysis module and the reliability calculation module could be combined intelligently. The feasibility of this algorithm is verified by reliability analysis of a numerical example and an actual bridge structure. Finally, reliability analysis under serviceability limit state is carried out with the background of 420m main-span twin-towers PC cable-stayed bridge. The parameter analysis indicates that under the vehicles load, the transfinite failure probability of mid-span displacement is higher than the strength failure of the longest cable; the mean and standard deviation of vehicle loads exhibit higher influence on reliability of the cable-stayed bridge; the reliability index of transfinite failure probability of mid-span displacement has a distinct decrease tendency with the increase of mean coefficient of vehicle load.

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