Bayesian Evaluation and Reduction of Economic Risk for Structural Health Monitoring using Weighted Regression

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ABSTRACT

This study is regarding a method for numerical evaluation of probability of failure (PoF) and Engineering risk by using Bayesian theorem from the diagnostic result of real-time condition monitoring. Engineering risk is defined by the combination of PoF and the consequences of failure as follows.

Risk = PoF × Consequences of Failure(CoF).

When performing maintenance using real-time monitoring results, a diagnostic result without any inspection error is ideal. However, failure is not caused even if the monitoring method sufficiently overestimates any small damage that can cause failure. Moreover, failure is not caused even if the method slightly underestimates large damage. In other words, for reducing the probability of failure, improving the accuracy of estimating specific damage levels is necessary. In this study, a method for reducing the risk by improving the diagnostic accuracy of specific damage levels by means of controlling the sampling ratio of the training data employed for learning the use of a weight function is proposed. The consequences of overestimation and underestimation of damage differ. The risk caused by underestimation is called failure risk and that caused by overestimation is called economic risk. In this paper, the method for numerical evaluation of the PoF using Bayesian theorem for each diagnostic result of real-time condition monitoring is proposed and the effect of weighted regression on risk reduction is discussed. The proposed method is validated by employing it to identify delamination in a CFRP beam via the electric potential change method.

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