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# Parameter Estimation Method Using Bayesian Statistics Considering Uncertainty of Information for RBDO

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## Abstract

The reliability-based design optimization (RBDO) has developed to meet the design requirements for reliability and safety considering uncertainties such as the applied load and material properties. The uncertainties are modelled as random variables based on probabilistic theory. The probabilistic parameters such as mean values or the standard deviations are estimated by statistical data or experiment and are usually assumed to be deterministic values. However, under actual situation, the parameter itself will have uncertainty due to lack of information. For example, if the number of experiments is limited, the estimated mean value and the standard deviation cannot be determined with sufficient accuracy and should be considered to have uncertainties.

This study proposes the parameter estimation method for the RBDO. On the estimation method, the parameters such as the mean value are considered as random values. Then, the probabilistic distribution of the parameter is evaluated based on Bayesian statistics and hence the confidence interval of the parameter is estimated. Then, the confidence interval of the reliability-based optimum design itself obtained by RBDO is evaluated. The proposed method can evaluate not only a point estimated solution, but also an interval solution in RBDO that relates to the accuracy of the point solution under lack of information.

Through numerical examples from references [1-2], the validity of the proposed method is demonstrated. In these problems, to simulate the lack of information, some of the standard deviations are set as unknown variables. Instead, it is determined from the simulation data from limited random numbers with normal distributions, where the standard deviations are set as the original problem [1-2]. In this research, it is found that the proposed method has a sufficient estimation accuracy regardless that it is estimated only from the limited number of sample data.

## References

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