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Sequential multidisciplinary design optimization and reliability analysis under interval uncertainty

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Abstract: With the rapid development of modern technology and the rising demand for high reliability in complex multidisciplinary engineering systems, more and more attention has been paid to reliability based multidisciplinary design optimization (RBMDO). The regular RBMDO is a triple-level nested optimization loop which is computationally expensive. In this paper, a sequential multidisciplinary design optimization and reliability analysis method under non-probabilistic theory is developed to decouple the reliability analysis from the optimization. The multidisciplinary design optimization (MDO), interval uncertainty analysis and the reliability analysis are conducted in a sequential manner. Furthermore, a dimension-by-dimension method (DDM) is proposed to conduct the interval uncertainty analysis. The calculation of the reliability under interval uncertainty is deduced based on the volume ratio theory. The shifting distance of the limit state function is also deduced. Both numerical and engineering examples are employed to demonstrate the validity of the proposed method.

Key words: reliability based multidisciplinary design optimization; sequential optimization and reliability analysis; uncertainty analysis; dimension-by-dimension method; shifting distance

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