Usage of Divide-and-Conquer Inverse Reliability Method in Probabilistic Structural Lifetime Prediction

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Engineering design aims to ensure minimum levels of serviceability and safety throughout the structural lifetime. This task is challenging due to significant sources of uncertainty that can lead to over- or under-design solutions. Reliability analysis methods provide a theoretical framework to comprehensively address these uncertainties in the decision-making process. The primary goal of reliability analysis is to assess the ability of systems or components to remain safe and operational throughout their lifecycle. However, a key issue with these methods is their one-directionality: while calculating reliability indices given material properties is relatively straightforward, determining the material properties needed to achieve desired reliability values is much more complex.

To retrieve the necessary parameters in order to obtain desired reliability index we use the divide and conquer approach. Since determining the reliability index can be done efficiently using the FORM (First Order Reliability Method) approach, adding the bisectional method of searching for its desired value boils down to adding a logarithmic time complexity to the whole method. This logarithmic term depends on the required accuracy of the result and, of course, on the dimensionality of the problem. Therefore, we believe our method to be a fresh and successful approach for this problem.

References

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