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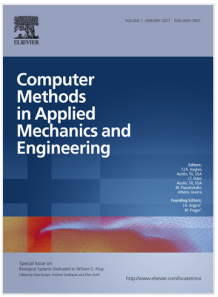

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A novel non-probabilistic reliability-based design optimization algorithm using enhanced chaos control method

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ABSTRACT

In this study, an efficient and robust algorithm of non-probabilistic reliability-based design optimization (NRBDO) is proposed based on convex model. In this double-nested optimization model, the inner loop concerns a Min-max problem for the evaluation of reliability index, where the target performance approach is applied to substitute the Min-max problem. To improve the convergence rate, an enhanced chaos control (ECC) method is developed on the basis of chaotic dynamics theory, which can check and re-update the control factor by the Wolfe-Powell criterion. To further enhance the optimization efficiency, a novel NRBDO algorithm is developed based on the proposed ECC, where HL-RF algorithm is applied at the initial stage of this algorithm, while ECC is used to improve the robustness once the oscillation or chaotic behavior is identified. Three mathematical examples, one numerical example and one complex engineering problem, i.e. axially compressed stiffened shells in launch vehicles, are utilized to demonstrate the robustness and efficiency of the proposed method by comparison with other existing methods. Results indicate that the proposed method is particularly suitable for complicated engineering problems without prior knowledge of uncertainty distributions, which is expected to be utilized in the structural design of future launch vehicles.

Keywords: *non-probabilistic reliability-based optimization; enhanced chaos control method; target performance approach; convex model; complex engineering problem*