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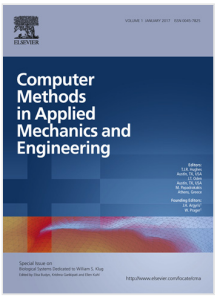

A general solution framework for time-variant reliability based design optimization

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A General Solution Framework for Time-variant Reliability Based Design Optimization

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Abstract: In this paper, a general solution framework called time-invariant equivalent method (TIEM) is proposed to solve the time-variant reliability based design optimization problems, which provides an efficient tool for reliability design of many complex structures or systems considering their whole life cycles. In each cycle, the proposed method constructs an equivalent time-invariant RBDO problem according to the time-variant reliability analysis results and then updates the design point by solving this problem. Therefore, the time-variant RBDO problem is decoupled into a series of time-variant reliability analyses and time-invariant RBDO problems that are alternately solved, which dramatically promotes the computational efficiency. Besides, an iteration mechanism is proposed to ensure the convergence of the whole optimization procedure. Finally, five numerical examples and an engineering application are investigated to demonstrate the effectiveness of the proposed method.

Keywords: time-variant reliability; reliability based design optimization; time-variant uncertainty; stochastic process

1 Introduction

As the uncertainties that widely exist in engineering problems, such as material parameter, geometrical size and external load, are not taken into consideration in traditional deterministic optimization, it may lead to unreliable optimization results. By treating uncertain parameters as random variables in the optimization procedure, the reliability-based design optimization (RBDO) is then developed which is able to obtain the optimal solution satisfying the reliability requirement.

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