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### 随机响应面法最优概率配点数目分析

#### Optimal probabilistic collocation points for stochastic response surface method

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中文关键词: [随机响应面法](#) [概率配点](#) [回归方法](#) [线性无关](#) [可靠度](#)

英文关键词: [stochastic response surface method](#) [probabilistic collocation](#) [regression method](#) [linearly independent](#) [reliability](#)

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作者	单位	E-mail
<a href="#">蒋水华</a>	<a href="#">武汉大学 水资源与水电工程科学国家重点实验室; 水工岩石力学教育部重点实验室, 武汉 430072</a>	
<a href="#">李典庆</a>	<a href="#">武汉大学 水资源与水电工程科学国家重点实验室; 水工岩石力学教育部重点实验室, 武汉 430072</a>	<a href="mailto:di anqing@whu.edu.cn">di anqing@whu.edu.cn</a>
<a href="#">周创兵</a>	<a href="#">武汉大学 水资源与水电工程科学国家重点实验室; 水工岩石力学教育部重点实验室, 武汉 430072</a>	

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中文摘要:

系统地研究随机响应面法采用线性无关原则选取概率配点的优越性,给出了基于线性无关原则选取概率配点的流程图,比较了基于回归方法和基于线性无关原则选取概率配点的优缺点。算例结果表明,基于回归方法选取概率配点时,配点数目应保证Hermite系数矩阵达到满秩,此时随机响应面法的计算精度才能得到保证,计算效率也远远高于传统的蒙特卡洛模拟方法。基于线性无关原则选取概率配点的随机响应面法在保证计算精度的同时,其计算效率远远高于基于回归方法选取概率配点的随机响应面法,它是结构可靠度分析一种有效的方法,尤其适用于极限状态方程不能用显式函数表达的复杂结构可靠度问题。研究成果为随机响应面法最优概率配点数目的确定奠定了一定的基础。

英文摘要:

The accuracy and efficiency of the SRSM based on the linearly independent probabilistic collocation points are studied systematically. The flow chart of the procedure based on principle of linearly independent probabilistic collocation points is proposed. Both the linearly independent probabilistic collocation points and the probabilistic collocation points using the regression method are compared. Two examples are presented to demonstrate that the selected number of collocation points should ensure the Hermite coefficient matrix having a full rank for SRSM based on the probabilistic collocation points using the regression method. In this situation, the accuracy of SRSM is sufficient enough. Furthermore, its efficiency is higher than the traditional Monte Carlo simulations. The SRSM based on the linearly independent probabilistic collocation points can result in the same accuracy as the traditional Monte Carlo simulations, and its efficiency is significantly higher than the SRSM with the probabilistic collocation points using the regression method, which may be taken as an alternative method for structural reliability analysis, particularly for the complex structural reliability problems with implicit performance function. These results can provide a basis for determining the optimal number of probabilistic collocation points for the application of SRSM to structural reliability analysis.

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