王维虎,吕震宙,李倩.基于Copula理论的模糊可靠度隶属函数求解的自适应截断抽样法[J].计算力学学报,2011,28(6):844~850

# 基于Copula理论的模糊可靠度隶属函数求解的自适应截断抽样法

# Membership function analysis of fuzzy reliability by adaptive truncated sampling on Copula theory

投稿时间: 2009-11-26 最后修改时间: 2010-05-11

DOI: 10.7511/jslx20116006

中文关键词: Copula理论 模糊可靠度 隶属函数 自适应截断抽样

英文关键词:Copula theory fuzzy reliability membership function adaptive truncated sampling

基金项目:国家自然科学基金(10572117,50875213);新世纪优秀人才支持计划(NCET-05-0868);航空基金(2007ZA53012);民口863计划课题(2007AA04Z401)资助项目.

| 作者 | 单位 |
| --- | --- |
| 王维虎 | 西北工业大学 航空学院, 西安 710072 |
| 吕震宙 | 西北工业大学 航空学院, 西安 710072 |
| 李倩 | 西北工业大学 航空学院, 西安 710072 |



中文摘要:

针对工程中同时存在随机和模糊基本变量且随机概率信息不全的可靠性问题,利用Copula理论逼近随机基本变量的联合分布函数和联合概率密度函数,进而建立了Copula逼近基础上的模糊可靠度隶属函数求解的自适应截断抽样法。所建模型在Copula逼近基础上采用优化建模和迭代策略,交替考虑模糊不确定性和随机不确定性对功能函数的影响,求得使功能函数取极值的模糊基本变量取值及随机基本变量设计点,然后再运用自适应截断重要抽样法求得给定隶属度水平下结构可靠度的上、下界,进而得到模糊可靠度隶属函数。所建方法充分利用了Copula函数对概率信息不全的逼近能力和自适应截断抽样法的高效稳健性,使得概率信息不全时的模糊可靠性分析能够高效地被完成。在详细给出建模原理和求解方法后,算例被用来说明模型的合理性和算法的可行性。

英文摘要:

For engineering reliability problem with fuzzy variables and random variables under incomplete probability information, Copula theory is employed to approximate joint distribution function and joint probability density function of the random variables, on which an adaptive truncated sampling method is established to obtain the membership function of fuzzy reliability. The established model on the Copula approximation can get the value of fuzzy variables and design point which make the performance function take extreme values by optimization and iterating strategy, on which an adaptive truncated sampling is employed to calculate the bounds of the reliability under each given membership level and to get the membership function of the reliability furthermore. In the established method, the advantage of the Copula approximation is combined with the efficiency and robustness of the adaptive truncated sampling, which makes the reliability analysis under incomplete probability information can be completed efficiently. After the model concepts and the solution are given for the established method, several examples are presented to demonstrate the rationality of the model and the feasibility of the solution.