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单测控站测控任务可靠性仿真的高效方法

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Efficient reliability simulation method for TT&C mission executed by single TT&C station

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- 摘要
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摘要 Markov模型及其直接仿真法在评价单测控站条件下的测控任务可靠性时都存在计算 复杂性的问题. 将强制法与失效偏倚法相结合, 用于测控任务可靠性的仿真. 在出现初始状态的情况下使用强制法将下一状态的发生时间限制在任务时间内, 在其它非吸收状态下使用失效偏倚法提高失效转移发生的概率, 并通过似然比将结合强制法与失效偏倚法得到 的仿真样本还原为测控任务不可靠度的无偏估计量. 证明了结合强制法和失效偏倚法的方差相对直接仿真有量级上的缩减, 能保证仿真结果相对误差的有界性. 通过实例验证了结合强制法与失效偏倚法的正确性与高效性, 能有效地解决单测控站条件下测控任务的可靠性仿真.

关键词: 航天测控任务 任务可靠性 强制法 失效偏倚法 重要抽样

Abstract: When evaluate the reliability of TT&C mission that executed by a single TT&C station, Markov model and its crude simulation are facing the problem of computation complexity. The forcing method and failure biasing method are combined together to simulate the reliability of TT&C mission. If current state is the initial state, the forcing method is used to constrain the next state transition occurred before the mission end time, while current state is other none absorption state, the failure biasing method is used to improve the possibility of failure transitions for next state transition. The likelihood ratio is given to get the unbiased estimator of TT&C mission's unreliability from simulation samples generated by combined forcing and failure biasing (CFFB). The variance of CFFB is proved much less than that of crude simulation, which can guarantee the relative error of CFFB is bounded. The accurateness and high efficiency are validated by examples, which means combined forcing and failure biasing is a suitable reliability simulation method for TT&C mission executed by single TT&C station.

Key words: TT&C mission mission reliability forcing failure biasing importance sampling

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[1] Sandmann W. Importance sampling in Markovian settings[C]// Proceedings of Winter Simulation Conference, 2005: 499-508.

[2] 郝岩. 航天测控网 [M]. 北京: 国防工业出版社, 2004.

[3] Shahabuddin P. Importance sampling for the simulation of highly reliable Markovian systems[J]. Management Science, 1994, 40(2): 333-352.

[4] Ross S M. Introduction to Probability Models[M]. 北京: 人民邮电出版社, 2007.

[5] Ridder A. Importance sampling simulations of Markovian reliability systems using cross-entropy[J]. Annals of Operations Research, 2005, 134(1): 119-136.

[6] Juneja S, Shahabuddin P. Rare-Event Simulation Techniques: An Introduction and Recent Advances[M]// HandBook on Simulation, Springer: North-Holland, Amsterdam, 2005: 291-350.

[7] L'ecuyer P, Tuffin B. Approximating zero-variance importance sampling in a reliability setting[J]. Annual of Operation Research, 2011, 189(1): 277-297.

[8] Sandmann W. Importance sampling in Markovian settings[C]// Proceedings of Winter Simulation Conference, 2005: 499-508.

[9] Shahabuddin P. Importance sampling for the simulation of highly reliable Markovian systems[J]. Management Science, 1994, 40(2): 333-352.

[10] Goyal A, Shahabuddin P, Heidelberger P, et al. A unified framework for simulating Markovian models of highly dependable systems[J]. IEEE Transactions on Computers, 1992, 41(1): 36-51.

[11] Ridder A. Importance sampling simulations of Markovian reliability systems using cross-entropy[J]. Annals of Operations Research, 2005, 134(1): 119-136.

[12] Nicola V F, Shahabuddin P, Nakayama M K. Techniques for fast simulation of models of highly dependable systems[J]. IEEE Transactions on Reliability, 2001, 50(3): 246-264.

[13] L'ecuyer P, Tuffin B. Approximating zero-variance importance sampling in a reliability setting[J]. Annual of Operation Research, 2011, 189(1): 277-297.

[14] Haque S A. A computational study of sparse matrix storage schemes[D]. Canada: University of Lethbridge, 2008.

[15] Goyal A, Shahabuddin P, Heidelberger P, et al. A unified framework for simulating Markovian models of highly dependable systems[J]. IEEE Transactions on Computers, 1992, 41(1): 36-51.

[16] Shahabuddin P. Fast transient simulation of Markovian models of highly dependable systems[J]. Performance Evaluation, 1994, 20(1): 267-286.

[17] Nicola V F, Shahabuddin P, Nakayama M K. Techniques for fast simulation of models of highly dependable systems[J]. IEEE Transactions on Reliability, 2001, 50(3): 246-264.

[18] Haque S A. A computational study of sparse matrix storage schemes[D]. Canada: University of Lethbridge, 2008.

[19] Shahabuddin P. Fast transient simulation of Markovian models of highly dependable systems[J]. Performance Evaluation, 1994, 20(1): 267-286.

[1] 王燕萍, 吕震宙. 基于G-M法和重要抽样法的PLP强度函数的Bayesian预测分析[J]. 系统工程理论实践, 2011, 31(11): 2217-2224.

[2] 陈荣达;王春发. 基于多元Laplace分布的外汇期权组合非线性VaR模型[J]. 系统工程理论实践, 2010, 30(2): 315-323.

[3] 梁亮;郭波;黄卓;史宪铭. 考虑设计迭代和资源冲突的研制系统任务可靠性[J]. 系统工程理论实践, 2009, 29(3): 186-192.

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