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故障相关的两部件并联系统可靠性建模及动态更换策略

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Reliability modeling and dynamic replacement policy for two-unit parallel system with failure interactions

摘要 为研究Ⅰ,Ⅱ类故障相关性同时存在维修计划的随机变动对系统可靠性和维修成本的影响,针对同时存在Ⅰ,Ⅱ类故障相关性的两部件并联系统,建立系统的可靠性模型并提出一种拟周期的动态预防性更换策略。模型中部件A的故障以概率p为一般故障引起部件B的故障率增加,以概率1-p为严重故障导致B故障|B的故障以概率θ2为严重故障导致A故障。系统故障后进行事后更换,预防性更换在给定长度的实施区间内根据动态计划随机进行。通过优化给出了最优预防性更换区间唯一存在的证明并得到运行区间大于更换区间的条件。案例结果表明,相关系数的增加或实施区间的增长会增加维护成本、缩短平均运行时间,制造企业应在满足实际需求的情况下尽可能缩短实施区间。

关键词 : 两部件并联系统, 故障相关性, 拟定期更换策略, 动态计划

Abstract : To research the coexist of type Ⅰ and Ⅱ failure interaction and the influence of random variation on system reliability and maintain cost in maintain plan,the reliability model of system and a quasi-periodic dynamic Preventive Replacement (PR) policy were established aiming at the two-unit parallel system with type Ⅰ and Ⅱ failure interaction.In the model,the hazard rate of unit B was increased by a failure of unit A as a minor failure with probability p,and the failure of unit B was caused by probability 1-p as a catastrophic failure.A failure of unit A was caused by the failure of B as a catastrophic failure with probability θ2.An unplanned replacement was performed when the system failed,and a preventive replacement was executed stochastically in an implemented period with a given length.A certification for the existence and uniqueness of the optimal implemented period was given,which could minimize the long run cost rate,and a condition that a running period was greater than an implemented period was presented.Numerical results showed that failure dependence parameters and the length of the implemented period should be decreased as soon as possible to meet the practical requirements,which could increase mean operating time and decrease long running cost rate.

Key words : two-unit parallel system failure interaction quasi-periodic replacement policy dynamic plan

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