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一种改进的RM可调度性判定算法

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Abstract

One of the key issues in real-time theory is the schedulability analysis of a given task set with fixed priority. All the proposed schedulability test methods can be classified into two types: polynomial time methods and exact methods. Polynomial time methods use a sufficient schedulability condition, and several least upper bounds of the processor utilization under ideal assumptions have been developed. Exact methods based on the necessary and sufficient schedulability condition guarantee that the test result for every task set is correct. However, the pseudo-polynomial complexity of the exact tests is too complex to be executed online for large task sets. This paper presents a novel ISTA (improved schedulability test algorithm) for analyzing the schedulability of periodic task sets under Rate Monotonic priority assignment. A pruning theorem for the Task_i space is derived, the schedulability correlation among tasks and its effect on the schedulability test are investigated, and the related theorems are proven. Based on the above results, a new improved pseudo-polynomial schedulability test algorithm is developed, and several comparative simulation experiments among the three methods are conducted. Extensive simulations show that the average schedulability test performance as a function of number of the tasks can be significantly improved.

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摘要

固定优先级任务可调度性判定是实时系统调度理论研究的核心问题之一.目前已有的各种判定方法可归结为两大类:多项式时间调度判定和确切性判定.多项式时间调度判定通常采用调度充分条件来进行,为此,许多理想条件下基于RM(rate monotonic)调度算法的CPU利用率最小上界被提了出来.确切性判定利用RM调度的充要条件,保证任何任务集均可被判定,并且判定结果是确切的.但是由于时间复杂度较差,确切性判定方法难以实现在线分析.提出了一种改进的RM可调度性判定方法(improved schedulability test algorithm,简称ISTA).首先介绍了任务调度空间这一概念,并提出了二叉树表示,然后进一步提出了相关的剪枝理论.在此基础上,研究了任务之间可调度性的相关性及其对判定任务集可调度性的影响,提出并证明了相关的定理.最后基于提出的定理,给出了一种改进的伪多项式时间可调度性判定算法,并与已有的判定方法进行了比较.仿真结果表明,该算法平均性能作为任务集内任务个数的函数具有显著提高.

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