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航空电子系统混合实时任务的双层调度

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Two-level Hierarchical Scheduling for Hybrid Real-time Tasks in Avionic Systems

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摘要 针对航空电子系统的实时性需求,提出满足综合模块化航空电子(IMA)构架的双层任务调度算法。通过加权轮转调度激活分区,并为分区提供固定的时间窗口,增强了系统的可预测性;分区内部采用可抢占的固定优先级调度,减少了高优先级任务的响应时间。算法支持混合任务集的调度:对周期的强实时任务,建立具有任意时限的任务模型,增强了模型的通用性,并通过计算任务的响应时间上界,推导出双层调度下的任务可调度条件;对非周期的弱实时任务,引入期望可调度的概念,保证了统计条件下的任务可调度性。通过仿真,分析了分区参数对任务调度实时性的影响。该算法考虑了混和实时任务调度情况,具有较强的通用性。

关键词: 航空系统工程   综合模块化航空电子   分层调度   可调度性分析   实时系统

Abstract: By considering the demand for real time performance in avionic systems, a two-level hierarchical scheduling algorithm is proposed for the integrated modular avionics (IMA) architecture. Each partition is assigned a dedicated time window and activated by the weighted round robin scheduling, which enhances the predictability of the system. Within the partition, the fixed priority preemptive scheduling is applied to reduce the response time of the tasks with higher priorities. The algorithm can be used for hybrid real-time task scheduling. For periodic hard real-time tasks, a task model with arbitrary dead-line is built to enhance its generality, and the schedulability conditions are derived under hierarchical scheduling by analyzing the response time bound. For aperiodic soft real-time tasks, the concept of expected schedulability is introduced to guarantee the real-time performance in statistics. The design and optimization of the partition parameters is also discussed, and a first fit method is proposed to solve the problem. The influence of the partition parameters on task scheduling is analyzed by simulations. This algorithm, which considers the hybrid real time task scheduling, has better erformance in generality.

Keywords: aviation system engineering   integrated modular avionics (IMA)   hierarchical scheduling   schedulability analysis   real-time systems

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