

# 面向 PIM 异构系统的 MTTF 感知的可靠性任务调度

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**摘要:** 随着图形计算和数据分析等访存密集型应用的繁荣, 内存内计算 (PIM) 被认为是解决日益严重的“存储墙”最可行的解决方案. 这种 PIM 系统高可靠性 (保证系统长时间高性能地正常运行) 在大数据时代显得尤为重要. 然而, 现有的基于异构系统的优化系统老化的任务调度算法, 没有考虑 PIM+CPU 系统的硬件特性, 如访存竞争等, 如果直接应用在 PIM+CPU 系统中不能达到较好的优化效果. 因此, 我们考虑 PIM+CPU 异构系统的特性, 对该系统建立了一个老化可靠性模型, 并提出了一个基于 MTTF 的任务调度算法 PIM-MTTF 来平衡整个系统的 MTTF. 实验结果表明, 与现有的异构系统调度的研究工作相比, 该方法能够将 PIM+CPU 系统的平均 MTTF 差异值平均降低 9.1%, 系统性能平均提升 13.1%。

**关键词:** 异构系统; 可靠性; 任务调度; 内存内计算

## MTTF-Aware Reliability Task Scheduling for PIM-based Heterogeneous Computing System

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**Abstract:** Processing-in-Memory (PIM) has been recognized as the most feasible solution to resolve the ever-aggravating memory wall especially as the boom of memory-intensive scale-out workloads such as graph computing and data analytics. The high reliability of this PIM system (ensuring that the system operates normally for long periods of high performance) is particularly important in the era of big data. However, existing aging-aware task scheduling algorithms for heterogeneous systems do not consider hardware characteristics (memory interference etc.) in PIM+CPU system, if it is directly applied in the PIM + CPU system, a better optimization effect cannot be achieved. Therefore, we built an aging reliability model for PIM + CPU heterogeneous systems and proposed an MTTF-based task scheduling algorithm, PIM-MTTF, to balance the MTTF of the entire system. Experimental results show that, compared to the traditional scheduling algorithm for heterogeneous system, the proposed method is able to reduce MTTF variation over 9.1% on average and improvement of the system performance by 13.1% on average for PIM+CPU system.

**Key words:** heterogeneous system; reliability; task scheduling; PIM

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