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Pareto front based realistic soft real-time task scheduling with multi-objective genetic algorithm in unstructured heterogeneous distributed system

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Abstract

Task scheduling is an essential aspect of parallel processing system. This problem assumes fully connected processors and ignores contention on the communication links. However, as arbitrary processor network (APN), communication contention has a strong influence on the execution time of a parallel application. In this paper, we propose multi-objective genetic algorithm to solve task scheduling problem with time constraints in unstructured heterogeneous processors to find the scheduling with minimum makespan and total tardiness. To optimize objectives, we use Pareto front based technique, vector based method. In this problem, just like tasks, we schedule messages on suitable links during the minimization of the makespan and total tardiness. To find a path for transferring a message between processors we use classic routing algorithm. We compare our method with BSA method that is a well known algorithm. Experimental results show our method is better than BSA and yield better makespan and total tardiness. © 2010 Springer-Verlag Berlin Heidelberg.

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Pareto Front Based Realistic Soft Real-Time Task Scheduling with Multi-objective Genetic Algorithm in Unstructured Heterogeneous Distributed System

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Abstract. Task scheduling is an essential aspect of parallel processing system. This problem assumes fully connected processors and ignores contention on the communication links. However, as arbitrary processor network (APN), communication contention has a strong influence on the execution time of a parallel application. In this paper, we propose multi-objective genetic algorithm to solve task scheduling problem with time constraints in unstructured heterogeneous processors to find the scheduling with minimum makespan and total tardiness. To optimize objectives, we use Pareto front based technique, vector based method. In this problem, just like tasks, we schedule messages on suitable links during the minimization of the makespan and total tardiness. To find a path for transferring a message between processors we use classic routing algorithm. We compare our method with BSA method that is a well known algorithm. Experimental results show our method is better than BSA and yield better makespan and total tardiness.

Keywords: DAG, Distributed system, Edge scheduling, Genetic algorithm, Heterogeneous system, Link contention, Multi-objective Optimization, Precedence constraint, Real time system, Routing, Soft real time, Task scheduling.

1 Introduction

Distributed heterogeneous system has become widely used for scientific and commercial applications such as high-definition television, medical imaging, etc.. These systems require a mixture of general-purpose machines, programmable digital machines, and application specific integrated circuits [1]. A distributed heterogeneous system involves multiple heterogeneous modules connected by arbitrary architecture and interacting with one another to solve a problem. More and more evidence shows that scheduling parallel task is a key factor in obtaining high performance in such a system. The common objective of scheduling is to map tasks onto machines and order

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