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Energy-aware scheduling with reconstruction and frequency equalization on heterogeneous systems

Key words: Directed acyclic graph, Dynamic voltage scaling, Energy aware, Heterogeneous systems, Task scheduling

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Introduction

- Many task scheduling algorithms have been proposed to minimize the execution time or energy consumption in systems.

- Disadvantages of existing methods:

  - The performance of these algorithms is evaluated based on one criterion in general
  - Many algorithms do not consider the individual computation cost of tasks on different processors
  - Many algorithms do not consider the relationship between the parent-node and child-node
  - Many energy optimization approaches are inefficient

Features of our method

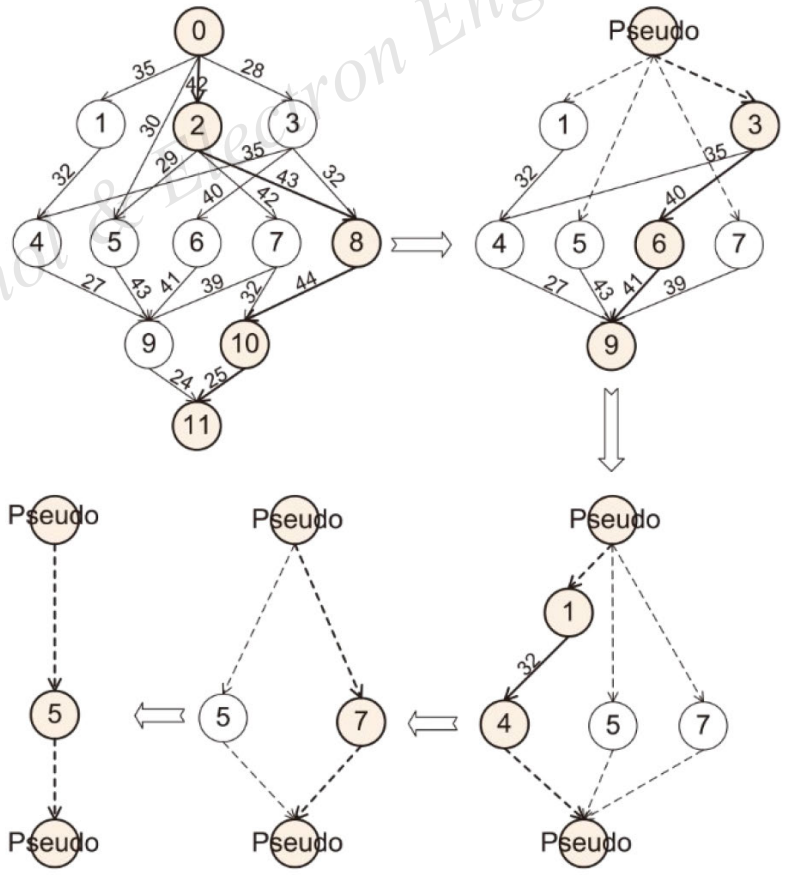
- The schedule length and energy consumption are considered in this study
- The method reconstructs a directed acyclic graph (DAG) for obtaining a reasonable schedule
- The individual computation cost of tasks on different processors is considered
- The relationship between the parent-node and child-node is considered
- Equalizing the frequency of tasks in an application in order to reduce the total energy consumption

Design method (I)

The algorithm can be divided into three parts:

1. Path determining phase

(The main goal of this phase is to determine the set of paths from an application)

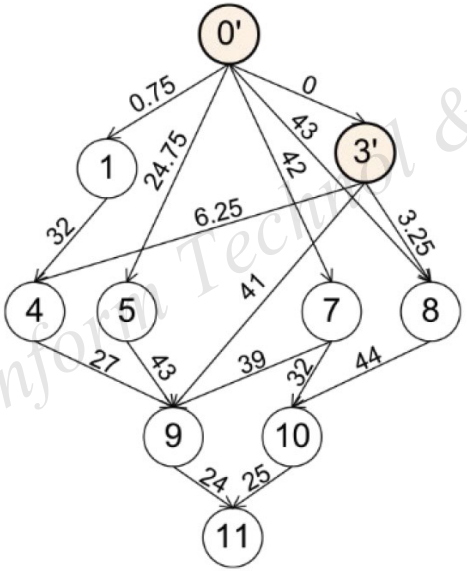


An example of the processing procedure

Design method (II)

2. Application reconstructing phase

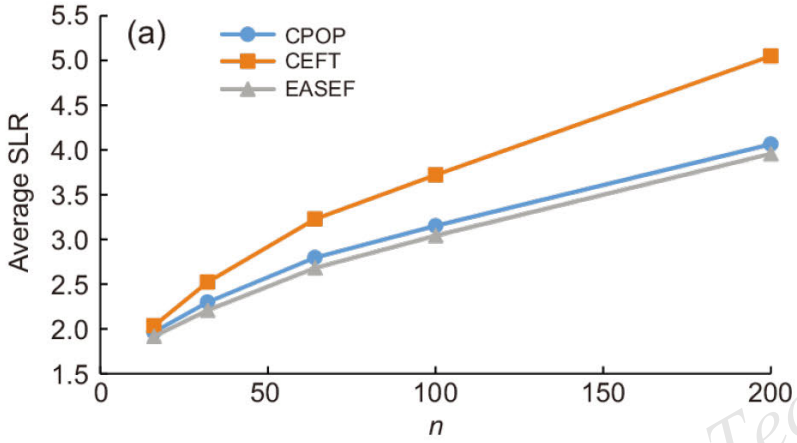
(The main goal of this phase is to deal with the tasks that can be merged according to the set of paths and the dependencies of tasks)

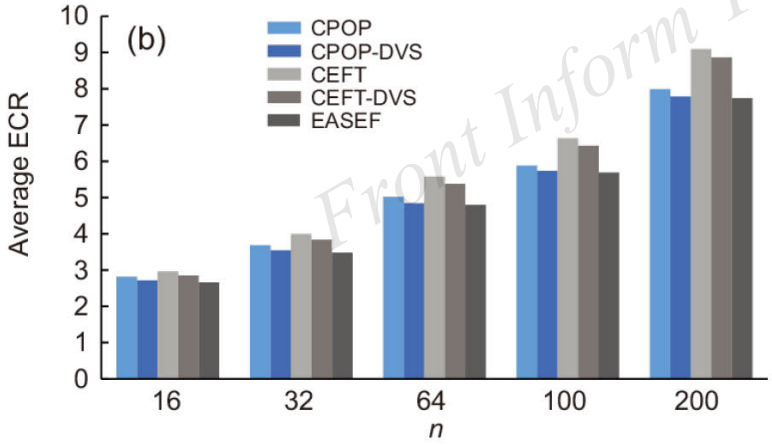


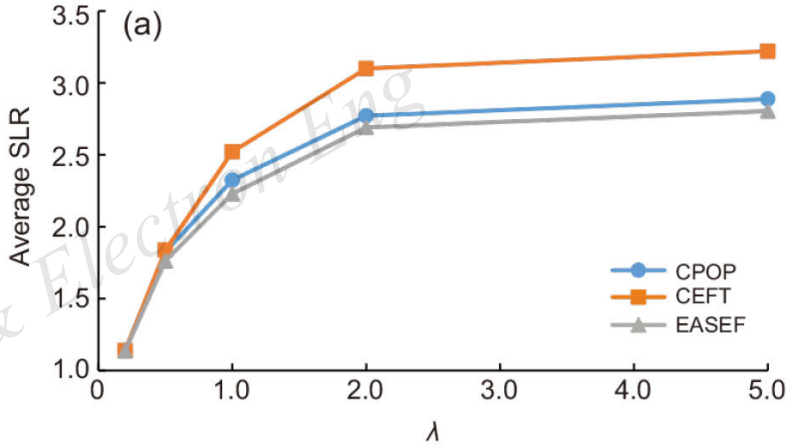
3. Frequency equalizing phase

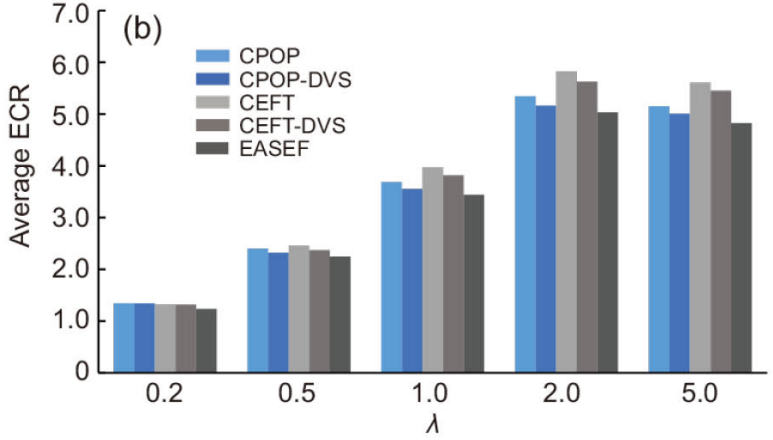
(The algorithm takes a progressive way to equalize the frequency of two adjacent tasks)

Major results









Conclusions

- A novel energy-aware scheduling algorithm is developed. The proposed approach comprehensively considers the communication and computation costs of tasks.
- The schedule length and energy consumption are considered in the study.
- The effectiveness of EASEF algorithm has demonstrated by extensive experiments.