3-Points Relationship Based Parallel Algorithm for Minimum Ultrametric Tree Construction

游坤明,Jiayi Zhou,Chun-Yuan Lin,Chuan Yi Tang
Computer Science & Information Engineering
Computer Science and Informatics
yu@chu.edu.tw

Abstract

To construct an evolutionary tree is an important topic in computational biology. An evolutionary tree can symbolize the relationship and histories for a set of species. There are many models had been proposed to resolve these problems. However, most of them are NP-hard problem. Ultrametric tree is one of the most popular models, it is used by a well-accepted tree construction method--Unweighted Pair Group Method with Arithmetic
Mean, which is widely used by biologists to observe the relationship among species. However, it is a heuristic algorithm. In this paper, we proposed a 3-Points relationship (3PR) based parallel algorithm to solve this problem. 3PR is a relationship between distance matrix and constructed evolutionary trees. The main concept is for any triplet species, two species closer to each other in distance matrix should be closer to each other in evolutionary tree. Then we combined this property and branch-and-bound strategy to reduce the computation time to obtain the optimal solution. Moreover, we put the lower ranked path which is determined by 3PR to delay bound pool (DBP) to accelerate the algorithm execution. DBP is a mechanism which can store the lower ranked path and can be helping algorithm to find a better bounding values speedily. The experimental results show that our proposed algorithm can reduce the computation time compared with algorithm without 3PR. Moreover, it also shows 3PR can reduce the computation time when number of computing nodes increasing.

Keyword：