先端科学技術研究科　修士論文要旨

所属研究室 (主指導教員)	ディペンダブルシステム学 (井上　美智子 (教授))		
学籍番号	2211188	提出日	令和 6年 1月 18日
学生氏名	茶円　春希		
論文題目	Extended Maximal P-star Partition and Its Silent Self-Stabilizing Algorithm		

要旨

In modern society, distributed systems in which a large number of computers are interconnected by networks, such as the Internet, are used.

In large-scale distributed systems, communication and computer failures are unavoidable, and it is therefore important to make algorithms and networks fault-tolerant.

Self-stabilizing algorithm is one of the ways to make a distributed system fault-tolerant.

The H-decomposition problem for graphs is the problem of finding a set of disjoint subgraphs isomorphic to a graph H and has applications in the fields of parallel computing and load balancing.

In previous research, a self-stabilizing algorithm for maximal p-star decomposition has been proposed.

A p-star is a complete bipartite graph $K_{1,p}$, and maximal is the property that a p-star cannot be formed only by processes that do not belong to a p-star decomposition.

In a maximal p-star decomposition, processes that do not belong to a p-star may appear.

Since processes that do not belong to a star cannot participate in parallel computation or load balancing, the efficiency of parallel computation or load balancing is reduced.

This paper introduces a new problem extended maximal P-star partition where maximal p-star decompositions are concurrently constructed for p = 0,1,..., P, for a given P.

The extended maximal P-star partition is a partition of nodes in a graph such that for any p (<= P), maximal p-star decomposition is constructed for a graph excluding nodes belonging to larger stars.

The proposed algorithm has the properties of silent and self-stabilizing under an unfair distributed daemon.

In the distributed algorithm, each node has a state and updates its own state by executing action.

In an unfair distributed daemon, there are no restrictions on the nodes that can be selected among the nodes that can execute actions at each time.

Silent is the property that when the algorithm starts from any initial configuration, it reaches a terminal configuration where no node is available to execute an action.

The time complexity of the proposed algorithm is O(n) rounds, and the space complexity is O(P log n), where n is the number of nodes.

The proposed algorithm only requires asymptotically the same space complexity as existing maximal P-star decomposition algorithms, which means that it drastically reduces space complexity with asymptotically the same round complexity compared to a fair composition of existing algorithms.