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A b s t r a c t

Title	Studies on Mechanisms for Adaptation to Environments in Self-Repairing Networks

(800 words)

This thesis studies on adaptation to environments in a self-repairing network. As scale and complexity of information networks increase, various kinds of networked systems appear and provide useful services for our society. The environments of information networks would be changed by unpredictable events such as software failures, computer viruses and worms. It would be more difficult to repair and even locate the failed nodes due to complexity and scale of the information networks. Fault tolerant systems have been long studied to achieve high reliable systems. Consequently, they can indeed realize high reliability and availability. However, it would cost to high to be used. Recovery-oriented computing has been proposed as an alternative way to construct high reliable systems. The self-repairing network is a mutual repairing model consisting of agents capable of repairing other agents. Agents need to adapt to environments and change a repair rate to maintain themselves. Adaptation to the dynamic environments is a crucial role for the agents. This thesis studies mainly three issues on mechanisms for adaptation to the environments in the self-repairing network.

Firstly, we consider synchrony of the self-repairing network. We introduce two repairing models (1) synchronous repair and (2) asynchronous repair to the self-repairing network. We compare two repairing models by carrying out multi-agent simulations. In simulations, we demonstrate that the self-repairing network with the asynchronous repair always eradicate all of abnormal agents under the almost conditions. Further, we propose a chain repair using the asynchronous scheme in the self-repairing network. The chain repair is defined to form a consecutive repair where the repaired agent will in turn repair the neighbor agents successively. We also investigate the performance of the chain repair by multi-agent simulations. According to the simulation results, the number of the normal agents increases as a repair success rate by normal agents rises. We summary the significance of the asynchronous model in the self-repairing network.

Secondly, we consider adaptation of the self-repairing network in dynamic environments. We assume that a probability to be abnormal from normal agents can be changed in the self-repairing network. We suppose that the environments change a failure rate with a fixed rate. We model the agents in the self-repairing network by a game-theoretic approach. We carry out multi-agent simulations and evaluate the performance of the self-repairing network. The simulations demonstrate that the agents change their repair rate to adapt for the environments. Further, we also study snapshots of the network configuration. According to the network snapshots, the agents organize themselves as clusters being same strategies. We confirmed that the self-repairing network adapt to the dynamic environments by multi-agent simulations.

Finally, we consider adaptation of the self-repairing network including a systemic payoff with distance effects. The systemic payoff includes distance effects in which the payoffs of the agents are weighted associated with distance. We define the self-repairing network with the square lattice network by the game-theoretic approach. We show that the agents keep a high available resource where the weights of the systemic payoff are sufficient large. Further, we consider the case in which the systemic payoff includes the payoffs of the agents located on a single radius. According to the simulation results, the agents are able to keep the higher available resource when the weights are large, even the agents collect the payoffs from the ones positioned at longer distance. We revealed that the agents are able to maintain themselves by mutual repairing even they collect payoffs within restricted locations and number of neighbor agents.

In concluding remarks, we summary the studies in this thesis. We review the motivations and the results of each chapter and conclude contributions of the studies. Finally, we argue future works for constructing the self-repairing network in dynamic environments.